COAL AGE

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The Highway to Profits

WHILE the stuffed shirts of industry sit with folded hands waiting for conditions to change, progressive management is busy changing conditions and bending circumstances to advance its fortunes. The highway to profits is still open for traffic—even in these dark days of depression.

MORE THAN sterile desire, however, is needed to set ambitious management firmly on this uncrowded highway. Business must analyze its own operations more critically than ever before and then have the high courage to take the steps which that study dictates if the journey is to be successful.

SUCH ANALYSIS necessarily starts with existing cost and performance records. In many cases, unfortunately, present operating and accounting records are in such shape that it requires deep mining to uncover the facts vital to a thorough-going, scientific survey within an individual company.

THAT these facts are embedded in the records is not enough. Accounting systems which do not facilitate the easy segregation, grouping, combination and regrouping of cost and operating data for executive study fall far short of the requirements of good management. Embalmed figures suggest mummified methods.

ADEQUATE cost records matched against accurate performance records give progressive management a true perspective on the changes in personnel, methods, equipment, and capital structure and investments which must be made if the red line of loss is to be squeezed out of the profit column. They open the way to action.

MANAGEMENT so buttressed does not shrink from scrapping good equipment and good methods for better ones because it knows that investing capital to buy greater net profits always is good business. It knows, too, that tomorrow's profits flow to those who anticipate tomorrow's demands today.

TO MANAGEMENT of this type the difficulties which confront the coal industry are a stimulus to fresh endeavor—not an alibi for inaction. Ample evidence of this statement will be found in the pages which follow. And yet the story there told of specific achievements of companies on the highway to profits only scratches the surface of actual accomplishments and future possibilities.

WHERE THE MONEY GOES

+ How the Operating-Cost Dollar Was Allocated by Soft Coal in 1931

TWO DISTINCT, and in some respects diametrically opposite, approaches to the question of cost analysis in the coal industry have been developed in the past fifteen years. In the early days of the Federal Trade Commission, encouragement was given to a study of costs as a means of ending profitless competition. The theory then stressed was that many coal producers were guilty of unfair competition in prices simply because they were ignorant of their true costs of production.

Further impetus to the axiomatic rule that it is impossible to establish profit-yielding prices on a commodity until the producer of that commodity has definite, accurate knowledge of the costs of its production came when the United States Fuel Administration was created and a scale of maximum mine prices was promulgated on the basis of admittedly incomplete data on costs furnished the President by the Federal Trade Commission. Operators suddenly denied the opportunity to participate in skyrocketing prices promoted by the frenzy of war-time demand for fuel discovered that they could not induce the Fuel Administration to agree to upward revisions of the Wilson maximum scale until they could convince the government authorities that the maxima so fixed did not return the producer his costs and a reasonable profit.

This approach was primarily one of using cost records to determine what price should be made to cover costs and profit. If any suggestion was made during that period that the study of costs should be directed toward an inquiry into the possibilities of reducing them to meet the prices established, such suggestion gained little currency in the discussions of the day. Interest in this second approach was not intensified until after the collapse of abnormal demand and the still later disappearance of boom markets which derived their stimulus from labor upheavals and transportation difficulties. Growth of competition from other fuels in the bituminous fields, the existence of surplus capacity developed to meet war-time requirements and to take advantage of the calamity props of strikes and car shortages, greater efficiency in the utilization of coal and the flattening out of the curve of demand have all sharply accelerated study of this second approach.

Interest in this second approach, however, is by no means confined to the coal industry. The changing conditions which have followed the end of "The New Era" with the Wall Street smash of the fall of 1929 have compelled more than one industry to consider how it best may reduce

Percentage Breakdown of Operating-Cost Dollar

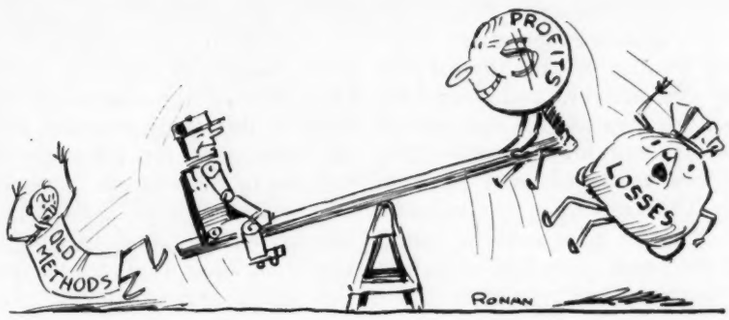
(Figures show range from low to high in percentage-cost allocations of operating expenses. Depreciation, depletion, taxes, insurance other than compensation, royalties,

Drilling and Shooting	Cutting	Per Cent of Coal Loaded *Mechanically*	Loading	Per Cent of Coal Loaded *Mechanically*	Drilling-Shooting Cutting and Loading	Per Cent of Coal Loaded *Mechanically*	Yardage and Deadwork	Timbering	Roof Condition (A)	Transportation	Hoisting	Transportation, Including Hoisting
0.48	1.26	95.3	16.38	100.0	30.05	.....	0.15	0.45	G	6.88	0.67	6.88
1.11	3.55	20.0	19.64	.....	34.15	3.3	0.40	1.00	G	7.10	1.01	8.40
1.30	4.52	3.3	22.50	.....	34.17	.....	0.54	1.68	G	7.16	1.28	8.44
1.38	4.70	.....	22.73	.....	35.54	100.0	1.24	1.80	....	8.60	1.30	8.96
1.60	5.55	.....	23.40	100.0	35.70	5.0	1.30	1.93	G	8.96	1.38	9.34
1.71	6.19	100.0	23.65	100.0	36.14	100.0	1.42	2.22	F	9.34	1.40	10.40
2.69	6.34	.....	26.12	.....	36.39	.....	1.76	2.33	G	10.23	1.43	11.35
2.74	6.40	100.0	28.87	.....	38.08	100.0	2.11	2.60	F	11.35	1.45	11.60
2.96	7.52	.....	29.33†	3.3	38.20	100.0	2.71	2.62	F	11.60	1.80	12.12
3.00	7.80	100.0	30.00	.....	38.96	100.0	2.71	2.68	...	12.33	1.90	12.60
3.60	7.80	44.0	31.22	.....	39.13*	100.0	2.79	2.92	G	12.60	2.44	13.71
4.69	7.90	.....	32.61	95.3	39.35	20.0	2.80	3.20	G	12.70	3.60	13.78
4.71	8.10	100.0	34.00	.....	39.68	95.3	3.01	3.23	G	14.70	4.96	14.70
5.71	8.30	19.7	34.33†	.....	39.94	43.4	3.07	3.60	G	14.80	9.57	14.80
5.81	8.39	.....	35.10	.....	41.72	5.4	3.10	3.79	F	15.71	.....	16.23
6.00	8.49	100.0	35.55	90.0	42.72	.....	3.18	4.00	G	15.90	.....	16.60
6.09	8.70	100.0	35.63	5.4	44.20	.....	3.40	4.00	G	16.23	.....	16.99
7.48	9.18	90.0	35.80	20.0	45.07	.....	3.94	4.25	F	16.60	.....	17.10
7.97	9.64	64.3	36.50	19.7	45.95	.....	5.70	4.37	G	16.69	.....	17.80
8.30	9.99	14.0	38.10§	44.0	46.37	.....	6.60	4.41	F	16.90	.....	18.30
8.40	10.00	.....	38.19	64.3	46.40	19.7	6.90	4.50	....	17.10	.....	19.07
9.28	11.20	.....	38.41	.....	48.20	51.0	7.34	4.51	F	17.69	.....	19.13
10.95	11.68	.....	38.44	100.0	48.50	36.0	7.97	4.63	F	17.98	.....	19.41
.....	12.04	.....	38.48	.....	49.50	44.0	8.02	5.04	....	18.44	.....	19.80
.....	12.42	100.0	45.98	14.0	50.00	.....	8.90	5.60	F	19.21	.....	19.83
.....	17.20	.....	46.37‡	.....	50.79	64.3	9.67	6.00	B	21.05	.....	21.05
.....	.....	.....	48.20‡	51.0	52.10	100.0	12.67	6.03	G	22.06	.....	22.06
.....	.....	.....	48.50‡	36.0	52.21	90.0	13.40	6.50	F	22.72	.....	22.72
.....	.....	.....	49.03	.....	53.90	.....	19.20	6.77	....	23.00	.....	23.00
.....	.....	.....	50.60	.....	55.58	100.0	.....	7.54	B	23.03	.....	23.49
.....	.....	.....	55.65	.....	55.65	.....	.....	7.56	B	23.49	.....	23.60
.....	.....	.....	56.50	.....	56.45	14.0	.....	9.30	B	23.60	.....	24.09
.....	.....	.....	.....	.....	57.80	.....	.....	.....	....	24.09	.....	24.39
.....	.....	.....	.....	.....	58.31	.....	.....	.....	....	24.39	.....	26.63
.....	.....	.....	.....	.....	67.80	.....	.....	.....	....	24.47	.....	27.47

*Also includes yardage and deadwork.
(A) Roof conditions are indicated by the following symbols: G = Good, F = Fair, and B = Bad.
(B) Gassy operations are indicated by symbol G; non-gassy operations, by N.

costs to live under a price it had lost all power of increasing. Profit engineering which tries to shave down costs to meet going prices, even if the shaving process involves an entire reorganization of the plant and sales set-ups, is now claiming more popular attention than the older type of production engineering which was concerned chiefly with stepping up output to satisfy increasing demand.

These changes also have brought a new attitude toward investments in equipment. Few, if any, operators of 1932 are interested in capital expenditures to increase the capacity of their mines. But progressive management is very much interested in methods and machinery which will increase unit productivity and thereby reduce unit costs. Investment for production finds little favor this year, but investment for profit probably is more welcome than ever before. Keen executives in the coal industry are encouraging their subordinates to make recommendations for capital investments which promise steady and quick returns. But no consideration is accorded to recommendations that



are not supported by engineering data which will give a factual basis for the proposals made.

The earlier approach to the cost question, of course, was relatively simple. As long as it was possible to obtain sales realizations which were large enough to cover all costs and profits, there was little call for detailed analyses of the various items entering into the total cost. There might be abstract questions of allocation as between actual operating costs and overhead and fixed charges. With today's big problem that of endeavoring to cut costs until the total is below average sales realizations, it is necessary to analyze closely where each penny in the operating-cost dollar goes.

Because natural conditions vary from mine to mine it would be dangerous and misleading, perhaps, to attempt to set up any fixed percentage divisions of the operating-cost dollar as a standard breakdown to govern the entire industry. But it is not improbable that a percentage analysis of the operating-cost dollar for the entire industry would show that there were common percentage groupings into which the allocations made by a large number of companies for a particular phase of the operating cycle would fall. Even groupings so established would not necessarily be conclusive as to an individual company or an individual mine, but to the extent at least that the percentage allocations of the individual company or mine varied materially from the major groupings, that variation would be a challenge to management to analyze closely the details of its own individual allocations to determine in what measure the variation was justified by difference in natural operating conditions and sound direction.

Every alert producer, of course, is familiar with the breakdown of his own operating costs. But little has been published on such breakdowns for individuals or for groups, and most of the data so published is too old to offer a workable measuring stick for today's operations. A preliminary inquiry into present percentage allocations was recently made by *Coal Age* in cooperation with a selected group of operators in both the anthracite region and in the bituminous fields. A summary of the anthracite results is published on page 136 of this issue. A summary of the bituminous results is shown in the accompanying table.

The inquiry into bituminous costs covered approximately 150 mines in 17 bituminous coal-producing states with an aggregate production last

at Selected Group of Bituminous Mines for 1931

sales costs, and general administrative expenses other than colliery accounts are not included in the figures used in arriving at the allocations shown below.)

Ventilation	Gassy or Non-Gassy (B)	Drainage and Pumping	Tipple Operation and Preparation	Power	Per Cent of Coal Loaded *Mechanically*	Other Direct Charges	Supervision and Engineering	Total Labor (*Exclusive of Power*)	Per Cent of Coal Loaded *Mechanically*	Total Supplies (*Exclusive of Power*)	Per Cent of Coal Loaded *Mechanically*
0.10	N	0.10	1.40	1.36	64.3	0.36	2.45	52.46	100.0	3.40	.....
0.14	N	0.10	1.67	1.65	.....	0.86	2.76	53.55	90.0	9.72	.....
0.43	N	0.12	2.30	3.21	.....	1.20	3.07	55.00	100.0	9.80	44.0
0.48	N	0.30	2.52	3.74	.....	1.38	3.20	59.47	95.3	9.95	.....
0.50	.....	0.30	2.90	3.90	100.0	1.42	3.86	67.68	.....	11.40	.....
0.50	N	0.40	3.75	4.40	.....	2.03	4.01	70.27	100.0	11.60	14.0
0.52	G	0.51	3.90	4.99	100.0	2.06	4.27	70.41	90.0	12.31	.....
0.67	N	0.54	4.00	5.00	36.0	2.10	5.00	71.90	5.0	12.33	43.4
0.77	G	0.80	4.13	5.46	14.0	2.12	5.12	72.51	100.0	13.00	20.0
0.80	N	1.10	4.14	5.60	.....	2.95	5.50	73.40	19.7	13.22	.....
0.90	G	1.14	4.31	5.82	5.4	3.05	5.54	74.72	12.0	13.33	.....
0.94	N	1.20	4.36	6.04	43.4	3.50	5.59	74.89	.....	13.50	.....
1.00	N	1.45	4.41	6.12	3.3	3.50	5.74	76.05	20.0	14.03	100.0
1.00	N	1.47	4.53	6.26	.....	4.06	6.10	76.35	100.0	14.09	100.0
1.04	N	1.59	4.54	6.43	100.0	4.32	6.11	76.60	36.0	14.26	12.0
1.10	N	1.59	4.74	6.59	.....	4.40	6.14	76.60	.....	14.32	3.3
1.20	G	1.75	4.77	6.70	.....	4.80	6.42	78.30	.....	14.90	.....
1.30	N	1.84	5.00	7.08	.....	6.35	6.63	78.41	100.0	15.24	5.4
1.37	G	1.86	5.10	7.20	19.7	6.58	6.94	78.90	44.0	17.60	5.0
1.39	G	1.96	5.50	7.50	.....	7.70	7.06	78.90	5.4	18.40	36.0
1.39	N	2.01	5.54	7.56	100.0	8.01	7.36	79.00	.....	18.66	100.0
1.47	N	2.03	5.90	8.02	100.0	8.25	7.39	79.50	.....	18.80	19.7
1.50	N	2.10	6.80	8.04	100.0	8.60	7.40	79.56	3.3	18.94	.....
1.61	G	2.18	6.82	8.12	.....	8.90	7.48	79.57	.....	19.65	.....
1.64	G	2.20	7.10	8.74	100.0	9.13	7.50	79.95	100.0	20.39	.....
2.00	G	2.22	8.04	8.80	44.0	9.89	7.60	80.05	.....	21.57	100.0
2.33	G	2.32	8.53	8.90	100.0	11.90	7.63	80.08	.....	21.69	100.0
2.48	G	2.40	8.58	9.80	51.0	12.21	7.90	81.63	43.4	25.15	100.0
3.85	G	2.63	9.30	10.20	5.0	18.03	8.40	82.96	14.0	26.71	95.3
3.90	N	2.64	10.20	10.71	90.0	18.40	8.66	82.97	.....	34.10	100.0
4.34	G	3.00	10.26	10.95	20.0	22.25	8.95	86.54	.....	35.74	90.0
4.35	N	4.43	10.74	11.02	.....	35.76	9.24	91.10	.....	38.84	100.0
8.50	G	.....	13.22	11.89	.....	.....	10.00	.....	.....	.....	.....
12.77	G	.....	16.32	13.38	.....	.....	10.03	.....	.....	.....	.....
.....	.....	.....	18.80	13.82	95.3	.....	.....	.....	.....	.....	.....

†Includes drilling and shooting.
‡Includes drilling and shooting, and cutting.
§Includes drilling for hand loading.

year of approximately 40,000,000 tons. No stripping operations were included because of the difference in primary cost accounts and allocations between the strip and the deep mines. The average working thickness of the seams covered ranged from 20 in. to 24 ft. The tabulation, it should be noted, is not by companies or mines, but by the range from low to high in the percentage allocations of the operating-cost dollar to different items of production expense. A company whose allocation to transportation, for example, may appear in the lower range may be among the high-allocation group in loading or in preparation. For several items (cutting, loading, power, and total labor and supply costs), the percentage of output loaded mechanically by the companies having the allocations shown also is given.

Because, with one exception, the percentage breakdown covers 1931 operations, in many cases certain allocations are higher than they would be in a year of steadier running time. This is particularly true at some mines with respect to allocations for timbering and for ventilation. On the other hand, unusually low allocations in certain other items represent conditions not common to the industry as a whole. The power allocation of 1.65 per cent of the operating-cost dollar, for example, comes from a mine where electrification is still to be done; the preparation allocation of 1.67 per cent is at an operation where the major charges for cleaning do not enter the mine accounts, but appear on the books of another operating organization.

The highest percentage allocations for loading are at mines where the average working thickness of the seam is 40 in. or less. In the three cases in which loading absorbs 50 per cent or more of the operating-cost dollar, however, the lowest percentage comes from the thinnest seam and the highest of the three from 40-in. coal. Another operation in 40-in. coal shows a loading percentage slightly more than half of 56.50 per cent. An operation in 6-ft. coal closely crowds the lowest-seam operation covered by this study in the percentage of the operating-cost dollar allocated to loading.

In a year when wages in many fields have been under the hammer, it might be expected that the percentage of the operating-cost dollar directly absorbed by labor would be less than in the days when it was common to say that 60 to 65 per cent of the coal-mine dollar was paid out in wages. Only four of the companies cooperating in this study reported percentage allocations for labor under 60; one was 67.68 per cent. Over 60 per cent of the companies reporting showed an allocation to labor ranging from 70.27 to 79.95 per cent of the operating-cost dollar. In one case, the labor allocation was 91.10 per cent of the operating-cost dollar. This was a hand operation in thin-seam coal.

Drilling and shooting percentage allocations show a wider variation than any other cost division (eliminating certain unusual allocations in the omnibus "other direct charges" item) reported. With a range from 0.48 to 10.95 per cent, the nearest approach to a common band covers allocations between 1.71 and 4.71 per cent: this band takes in approximately 34 per cent of the total figures. In the case of cutting, allocations between 6.19 and 8.70 per cent take in 46 per cent of the total reported. Allocations to loading range from 16.38 to 56.50 per cent of the operating-cost dollar, with slightly over 50 per cent of the figures ranging 28.87 and 38.48 per cent. Combined allocations for drilling and shooting, cutting and loading show over 50 per cent of the allocations falling between 38 and 50 per cent of the operating-cost dollar.

In the case of yardage and deadwork, with a range from 0.15 to 19.20 per cent of the operating-cost dollar, 38 per cent of the figures are found in the band between 2.11 and 3.94 per cent. The lowest allocations for this item are at fully mechanized mines. Timbering allocations range from 0.45 to 9.30 per cent of the operating-cost dollar, with 59 per cent of the figures falling between 2.22 and 4.63 per cent. As might be expected, the lowest allocations to timbering are in operations with good roof conditions; the highest at mines where roof conditions are bad. Here, with an occasional exception, a definite relation between roof conditions and the percentage of the operating-cost dollar absorbed by timbering seems apparent.

When it comes to ventilation, however, the relationship between percentage allocations and gassy or non-gassy mines appears to be less marked. While the lowest allocations are at non-gassy mines, the third highest allocation is also for a non-gassy operation. As previously explained, the high percentage in this division is abnormal because of poor running time and a reduced working force during 1931. Some of the company reports cover both gassy and non-gassy mines and in these cases ventilation costs at the non-gassy mines help to offset the higher costs at gassy operations and so bring down the average as compared with a single gassy mine. Sixty per cent of the ventilation allocations fall between 0.50 and 2.00 per cent of the operating-cost dollar. Allocations to drainage and pumping, with a range of 0.10 to 4.43 per cent of the operating-cost dollar, show over 33 per cent of the reports falling between 1.10 and 1.96 per cent of the operating-cost dollar and approximately 66 per cent between 1.10 and 2.64 per cent of the operating-cost dollar.

Transportation charges, including trackwork but excluding hoisting where hoisting has been separately allocated, fall into four groups. Seventeen per cent of the figures lie in the band covering allocations of 6.88 to 9.34 per cent of the operating-cost dollar; 23 per cent in the band between 10.23 and 14.80 per cent of the operating-cost dollar; 31 per cent in the group covering allocations between 15.71 and 19.21 per cent of the operating-cost dollar; and 29 per cent in the band ranging between 21.05 and 24.47 per cent of the operating-cost dollar. Companies making separate allocations for hoisting were in the minority in the reports received. The range was from 0.67 to 9.57 per cent of the operating-cost dollar with 64 per cent of the figures falling between 1.01 and 1.90 per cent. Combined figures for transportation and hoisting, ranging from 6.88 to 27.47 per cent of the operating-cost dollar, show the same definite groupings as in the cast of transportation alone: 14 per cent of the figures covered a range from 6.88 to 9.34 per cent of the operating-cost dollar; 26 per cent, between 10.40 and 14.80; 31 per cent, between 16.23 and 19.83; and 29 per cent between 21.05 and 27.47 per cent of the operating-cost dollar.

Charges for tipple operation and other surface preparation absorbed from 1.40 to 18.80 per cent of the operating-cost dollar. Mass groupings within a narrow percentage

(Turn to page 137)

ANTHRACITE COSTS

+ For the Directorate Manager and Engineer

WITH constantly decreasing prices and a fixed wage scale, anthracite companies are availing themselves of economies derivable from modernization. In all lines of improvement, progress is being made. In some directions anthracite sets the pace; in others the bituminous region's methods are accepted with such modifications as will fit them to pitching beds, broken roof, and second mining.

Most outstanding among the developments is mechanized car loading. This takes two forms. Where the coal has not been first-mined, conditions resemble those in bituminous working. Longwall is feasible and occasionally adopted, but most companies are not working by longwall methods but are merely driving rooms and removing pillars.

At one mine, three chambers are being worked together, using a common hoist and scraper. The rooms are 25 ft. wide and 275 ft. long. In 201 starts and 1,212 man-days, 8,218.75 short tons was produced, an average of 6.79 tons per man-day. The seam mined is 40 in. thick and has 4 in. of loose black slate over the coal; otherwise the coal is clean.

Two miners and three laborers are employed in each group of three chambers. One miner and one laborer prepare the coal on the night shift, and one miner and two laborers load it out on the day shift. The labor cost for driving these rooms is $1.429, the material cost $0.152, and the total cost $1.581 per produced ton. By hand methods this coal would cost $2.317, a difference of $0.736 per ton.

The price paid is based on a contract rate of $1.65 per miner's ton of 27 hundredweight, plus 14c. per inch per running yard for all refuse over 10 in. thick, and no payment for less than 10 in., with $30 for flitting scraper equipment from room to room. Bad roof is paid for at a price of 18c. per inch for each running yard.

Hand-loaded coal without the scraper to assist is paid for at $2.18 per miner's ton of 27 hundredweight. Top or bottom rock rates—the 4-in. drawslate not being included—are 18c. per inch per linear yard. In driving a room, 24 in. of this rock must be taken. Vein refuse must be

paid for at a rate of 16c. per inch per linear yard, a charge that provides for the 4-in. capping over the coal. In addition, a lump sum of $8.22 is paid for each chamber and $1.85 is paid per linear foot for crosscuts, which is straight yardage, additional payment being made for all rock that falls.

With the scraper much expense is avoided on transportation because the coal is loaded in cars at the heading. Without these savings the coal could not be mined at all, so in a sense they are not savings at all, merely means of operating coal too thin for hand-labor methods. With every reduction in the price of coal, more and more thin coal would tend to be unworked if it were not for the introduction of such methods of economy.

At another mine where the coal was so thin that 70 per cent of the material moved in the headings was rock and only 30 per cent coal, pit-car loaders were introduced. Rock was shoveled onto these conveyors off sheet-iron plates. This made it possible to reduce the cost for yardage from $36 per yard to $20, thus saving $16, or 44 per cent. By putting five men in the roadway instead of three, the rate of advance was multiplied 2½ times.

Another example of the manner in which seams can be worked under difficult circumstances was the removal of a pillar 80 ft. thick, approach to which was blocked by the falls in an adjacent room. This pillar had to be skipped. The coal was 46 in. thick, but over it was 6 in. of black slate. After shooting, the coal was gathered and drawn to the gangway by a scraper loader operated by a 7½-hp. hoist, costing $725 complete. In 97 starts comprising 294 man-days, the 2,560.35 short tons in this pillar was removed, making 8.70 tons per man-day. Labor cost was $0.954 per produced ton; material expense, $0.198; and total cost, $1.152. By hand methods this would cost $1.60, so the saving is $0.448 per produced ton. In drawing this pillar two miners and three laborers were employed, and the work was done on the open end.

Improvised shaker conveyors have given at one company's mines the following result: labor cost, $1.299; material cost, $0.272; total cost $1.571; all per produced ton. By hand-labor methods the cost would have been $2.175, a saving—if indeed it can be so designated, for reasons just outlined in another instance—of 60.4c. per produced ton. In this case the rooms were 25 ft. wide and worked in pairs by three men, a miner and two laborers. The coal was 43 in. thick and the refuse above the coal 8 in. thick. In 98 starts and 477 man-days, 2,306.1 produced tons was

obtained, or 6.70 produced tons per man-day. The equipment for each room cost $600 complete.

Other mines gave the cost of shaker equipment, including drive, motor, starter, connecting chute, connecting rods, 300 ft. of shaking chutes, ball frames, jacks and chute guides, at $1,646, though it may cost $1,800 before it is installed in place. The rate per ton is not changed from that formerly paid for direct loading into the car, but the men drive up the skip at the regular coal-loading rate.

With power 1.2c. per kw. hr., the cost of running the 7½-hp. drive for a period of, say, 4 hours daily is only 24c. Figuring the depreciation of the motor and all accessories at 20 per cent per annum, and the depreciation of the drive at 10 per cent, and assuming 200 days of operation over which to spread the cost, the depreciation will equal $1.376 daily, or with power $1.616. A fair limiting figure would be $2 a day.

An official at these mines said that he estimated that the equipment paid for itself each time it drew its second pillar. As the pillars are small and their content with 3-ft. coal not much over 700 tons, they should be cleaned out in about two months. Thus the cost of the equipment would be returned in a little over four months, provided, of course, the thin coal considered could be mined at present prices without the help of that or similar equipment.

A company mined seven near-by places with the aid of conveyors, and produced in 7,847 man-days 52,615 produced tons, or 6.70 produced tons per man-day. Here the coal was 49 in. thick and was covered by 7 in. of refuse, a black slate which came down with the coal and was gobbed. The total labor cost was $1.715, the material cost was $0.120, and the total cost was $1.835 per produced ton. With hand-labor methods this coal would have cost, all expenses considered, $2.317, a difference of 58.2c. In order to use these methods 3 ft. of bottom at 18c. per inch would have had to be lifted. A charge of $4.50 would have been made per yard of advance, merely for the removal of the coal. At further cost crosscuts would have been driven at 50-ft. centers. The roadways of such rooms would have been 10 ft. wide and the rock gobbed in the room, which is 20 ft. wide.

In this particular job all the coal loaded by conveyor methods was undercut by machine. This part of the work was paid for at the rates given. The men maintained the equipment themselves. One of the men was required to be a competent mechanic. The group worked as a whole. There were 20 men in each shift, or 40 men in all.

In such cases as these a contract is made with the union. The miners are given $9 to $11 a day and the laborers $8 to $10 a day. When the tonnage rates are figured these rates are adjusted, and when the reckoning is made the wages received are found invariably to be greatly increased. Decrease in cost to the company in removing room pillars comes not so much from the price at which the coal is mined, if at all, but from the saving effected by not lifting bottom, not cleaning up old and fallen rooms, not supporting a wide room with timber, not providing or laying track, ties and switches, and not placing and gathering cars on steep pitches.

Another advantage is that the getting of coal is at no time delayed by the handling of rock, and no rock has to be removed to other chambers and stowed away. As for the miner, he finds he has, with a skipped pillar, a shorter distance to shovel the coal. The roads in old rooms were in the center line of the room. Thus the coal would have to be transferred not only across a narrowed pillar but, in addition half across the width of the room. Furthermore, a wall of gob would lie between the road and the pillar, and this would have to be removed. Elimination of this labor saves the operator much cost. So the arrangement is of advantage all around. It makes coal mineable that might for years have to be left awaiting a higher market price. The nearhand pillars also can often be removed instead of going far afield, thus lowering, at least temporarily, the transportation cost.

Another company reports that it installed a permissible storage-battery locomotive which paid for itself in a year by the displacement of mules and the reallocation of drivers. An automatic pump which cost $2,800 saved $750 a month in attendance. Here it may be remarked that a company having a 6-in. 6-stage 1,000-gal. per min. pump, lifting water 550 ft. introduced automatic control devices that cost $1,050 but not bearing thermostats. Its maintenance cost of the control for the year was $75.14, and for material $72.24. The cost of operating labor would have been greatly reduced if the full measure of saving of automaticity had been obtained; namely, a man on each of three shifts. As 1931 was a year with low precipitation, when the difficulty was to locate rather than to remove water, the saving per year in labor was only $300.

Protective hats are used by 95 per cent of its men, says one company. Though this company has no exact figures on the savings from head injuries, it does know that in the year 1931 two lives were saved by the use of such hats. While it declares that a life cannot be translated into terms of dollars and cents, the compensation cost of these two lives would have been over $8,000.

Thirty per cent of the employees use safety goggles. This protection to the eyes was introduced only on Jan. 5 of the present year. The men objected to goggles because, in damp

Percentage Distribution Costs for Nine Companies in the Anthracite Region Arranged in Order of Magnitude

	Percentages of Total Operating Cost							
Drilling, shooting, cutting and loading	28.50	32.09	34.38	36.06	37.76	40.0	40.3	49.10
Per cent of coal loaded mechanically	18.0	.....	25.58	1.5	65	.....	70	0
Yardage and deadwork	4.0	7.0	8.0	12.54	14.28	16.41	20.44	25.10
Timbering	1.07	4.5	5.66	6.0	6.68	7.85	7.87	14.50
Roof condition	S	F	.....	.....	B	F	F	VB
Transportation (including track)	9.40	10.82	12.28	12.39	13.00	14.00	17.32	19.47
Hoisting	1.02	1.07	1.13	1.29	2.00	3.07	3.50	3.56
Transportation (including hoisting)	10.47	13.41	13.89	15.95	16.00	16.50	18.61	20.49
Ventilation	0.58	1.00	1.57	2.00	2.68	3.00	3.64	3.91
Gassy or non-gassy	G	N	G N	.....	N	.....	G	N
Drainage and pumping	0.68	1.00	1.20	1.53	1.95	2.00	2.19	2.37
Preparation and dumping	4.21	5.47	6.37	7.82	7.85	8.00	8.90	10.00
Power	3.84	4.10	5.36	5.67	7.00	7.51	8.98	18.00
Per cent of coal mechanically loaded	1.5	25.58	18	0	.....	.....	65	70
Other direct charges	0.00*	3.14	3.66	3.77	4.50	5.58	5.68	6.00
Supervision and engineering	2.01	3.64	3.91	4.65	5.44	6.00	6.23	.....
Total labor (exclusive of power labor)	75.00	78.14	78.52	79.95	81.00	82.11	84.45	85.87
Per cent of coal mechanically loaded	.....	65	25.58	.....	.....	18	1.5	0
Total supplies (exclusive of power supplies)	6.78	9.97	11.50	12.20	13.42	17.38	17.60	18.43
Per cent of coal mechanically loaded	0	1.5	.....	.....	18	25.58	.....	65

In table, G connotes gassy; N, non-gassy; S, good roof; F, fair roof; B, bad roof; V.B. exceptionally bad roof. * Compensation is omitted in this item and in all the calculations for this company. In other instances, compensation is regarded as an operating cost but one not to be classified under either labor, supplies or power.

places, they became hazy, but these objections probably were due to the newness of the idea. One has to get used to wearing them. To date 242 pairs have been sold, but even those who have bought them are induced with difficulty to wear them. But examples are rapidly developing interest and acceptance. One man who was not wearing them, but had them in his pocket, had an accident and may lose his eye. Another wearing goggles had them shattered, and his eye was saved. Because of the short experience, figures may be illusory, but in January there were seven eye injuries; in February, four; and March 1 to 23, inclusive, only one.

That safety records can be improved is evidenced by the record of one company. In 1925, that company had an accident frequency of 126.021, against 94.677 for the whole industry. In 1927 it was still no better—131.01, against 99.552 for the whole industry. Then a competent safety engineer was appointed. As the company was not large, however, he was assigned to some additional duties. In 1928, the frequency had dropped to 97.411, against 88.116 for the whole industry. Next year the frequency of the industry had risen to 101.355, and the frequency of this one company had declined to 67.823. In 1930, the frequency had further dropped to 53.817.

When there are only a few dollars available, just how many shall be allotted to any one item becomes a matter of much interest. *Coal Age* has, therefore, collected some sample representative studies of the cost breakdown of anthracite mining companies, covering a substantial percentage of the production of the field, so that the table, setting forth the broad range, of percentage distribution costs and shown on page 136, might be prepared.

Some explanation of this table is needed. It will be noted that there are only eight figures shown in the distribution columns. This is because, in one of the company reports received, the distribution into labor and supplies was not given and because another did not allocate supplies or maintenance, making it impossible to calculate the figures for distribution by operating functions. When one report was defective in the figures desired, the other contained the required facts, and vice versa, so eight columns are entirely filled, but they comprise a study of nine distinct companies.

The figures for distribution ranged

under one another do not refer to any one company, for they are distributed wholly according to magnitude. In one horizontal line Company G may be first and Company I last—to use letters which do not appear in the chart, and in another horizontal line Company I may lead and Company G be somewhere later in the line. Thus, it will be impossible from the figures for the reader to prepare a complete distribution for any one company.

Any company, however, having a certain timbering cost, for instance, will be able to see how this charge compares proportionately with those of other companies. If this operator's timbering cost is 6.15 per cent, for instance, then he will know that there are four companies whose figures are higher and four whose figures are lower and that his own figures are not out of line.

Under the figures for drilling, shooting, cutting, and loading may be seen the record of the percentage of coal loaded mechanically at that particular operation, or group of operations; under the figures showing timbering, the notation as to the roof condition reported; under power, also the degree of mechanization; under labor and under supplies, the same information is repeated. It is necessary to restate the degree of mechanization because the order in which the various distribution records are arranged is not the same.

Because the methods of submitting these accounts varied, the reports received have had to be recalculated. Some accountants had put royalties, administrative salaries and expenses, taxes other than federal, general insurance, depreciation and depletion among the operating costs from which the distribution is to be made. There may be good grounds for this procedure, but for comparisons a definite yardstick must be used. It was provided, therefore, that these percentages be stricken out and the percentages recalculated, so that the other items thus proportionately increased would total to 100 per cent. Where the direct charges included workmen's compensation, cave damage or general colliery expense, they were included in the final figures. If they involved labor, credit was given under the caption "Total labor exclusive of power," and also when they involved supplies, credit was given under the caption "Total supplies (exclusive of labor supplies)," but these items, in so far as they did not fall in the labor or supplies classes, found their way into a fourth omnibus class additional to the three main classes, which are, of course, labor, supplies and power.

Mines represented in the table number 41 and are found in the Northern, Middle and Southern fields and therefore may truly be regarded as representative of the anthracite region.

▼ ▼ ▼

How Operating-Cost Dollar Was Allocated By Soft Coal in 1931

(Continued from page 134)

range are not heavy in this division: the largest single grouping, covering allocations from 4.13 to 5.00 per cent of the operating-cost dollar, represented 29 per cent of the figures in this division. It is apparent that costs in individual cleaning and preparation plants vary widely, although, when the sales value of properly cleaned and properly sized coal is considered, the percentage of the operating-cost dollar absorbed in this division is not large. This variation is borne out by estimates from other sources which are not included in the present tabulation. These estimates, on the basis of treating mine-run coal with 60 to 80 per cent of the coal mechanically cleaned, show that the cost of screening and picking will range from 0.65 to 1.48c. per ton; operation of the cleaning units and sizing after cleaning, 1.05 to 2.27c.; mechanical drying and filtering, 0.84 to 1.15c.; loading, mixing and shipping, 1.01 to 1.41c.; heat drying, 0.50 to 1.13c.; sampling and testing, 0.25 to 0.60c.; general repairs, electrical repairs and lubrication, 0.75 to 1.25c. per ton.

PROFIT POSSIBILITIES + In Face Preparation

DEPENDING on a combination of a few or many factors, face preparation—here used as embracing cutting, drilling, and blasting—may take an appreciable part of the operating dollar. The figures collected for this cost analysis show a range for this step of operation of 6.09 to 21.70 per cent. Face preparation costs will be high if lump coal is the goal, if the coal is tough and not easily broken, if the seam is thin or the bottom is rolly, if mechanized loading is intense, and if, in the case of hand-loading mines, company men do the drilling and shooting, or certified shotfirers are employed.

The broad figures go little farther than to point out a relationship between costs and loading methods. Mobile-loader operations as a group take on the highest cost, and hand loading the lowest, with plants using other methods of mechanical loading falling irregularly between. So, if comparisons are made, they should be confined to the results of plants within only one of these groups, and then with attention to details. Any company that feels its costs high by such comparison can find the answer only by dissection and putting together.

Perhaps the cutting cost is high. If so, first look to the equipment. Should it be that track-mounted cutters are not being used, conditions and methods allowing, an opportunity is unfolded of eliminating 5c. or more per ton from the cost in one fell swoop, as the accompanying table giving the economy performance of 35 machines of this type indicates.

Even if track-mounted units are used, if the cost is high, an investigation of the equipment might profitably be made. Aside from the potentialities of improvement by general maintenance methods, as by close inspections and proper lubrication, an eye turned in this direction would find two other opportunities to pare pennies from the cost. These are the use of special abrasion-resisting cutter chains and alloy steel bits, or common bits weld-tipped with compounds of silica with such metals as tungsten or molybdenum. This latter opportunity is dramatically revealed by the maintenance-cost figures for Mines 3 and 8 in the table.

But profit making does not lie solely in cutting from the operating cost. Very real profits may be made by planting additional costs. Preparation at the face offers much uncultivated soil which might be tilled for this growing of new profits. One of the plantings might be shearing, which, though it adds to cutting cost, saves several times its expense in loading, if mechanical, and in drilling and shooting. The increased increment of profit realization from quality improvement in the product is so much more added (note the performance figures of Mine 7 in the table). In point of tonnage cut, 400 tons per shift, this plant does not compare favorably with several of the other plants listed. Yet, because of shearing, the loading machines following the cutters have attained a high production of 400 tons per shift in only 5 ft. of coal, as other data contributed by the owners to this study show.

Electric coal drills may, in a sense, be considered as adding somewhat to operating cost if thinking is not in terms of real wages for manual drilling in hand loading. The electric drill may be idle much of the shift,

(Turn to page 141)

Performance Comparisons of Track-Mounted Cutting Machines

Mine	Seam Thick. Feet	Cutting Horizon	Hard. of Cutting	Width of Cuts, Ft.	Traveling Between Cuts, Ft.	Loading Method	Wide Cuts in 8 Hr.	Tons in 8 Hr.	Short-wall Equiv. 8 Hr.	Wide Cuts per Bit Set	Mainten. per Ton, Cents	Deprec. per Ton, Cents	Saving Over Short-wall per Ton, Cents
1	5-5.5	Coal, on btm.....	Soft.....	10 and 21	300–500	Mobile loader	14	584	324	4–5	0.55	1.5	*f*
2	8	Coal, on btm.....	Extra hard...	12 and 22	500–1,000	Mobile loader	6	240*a*	190	1	....	4.0	3.0
3	7.5	Coal, 5 ft. above btm.	Med. sulphur	12 and 30	300	Pit-car loader	11	450	300	4–5*b*	0.37	....	4.0
4	4.75	Impur., 4 ft. above btm. *c*	Med. hard...	18 and 225*c d*	250	Hand.....	..	375	200	1 set ea. 112 ft.	....	0.5	3.0
5	7	Coal, 24-in. above btm.	Med. hard.....	21 and 30	1,000	Pit-car loader	15 wide and 3 narrow....	950	270	2	0.33	....	5.35
6	7	Coal, at roof.....	Soft.....	12 and 15	250	Hand.....	21 wide and narrow....	400	200	...	....	0.01	*g*
7	5	Coal, on btm.....	Med. hard....	8.5 and 22	340	Mobile loader	10	400*a*	...	1	2.72	1.93	*h*
8	7.5	Coal, on btm.....	Hard.....	15 and 30	700	Pit-car loader	9 wide and 3 narrow....	600	300	2*b*	0.8	1.5	3.0
9	5–8	Boney, 22-in. above btm.....	Med. hard.....	12 and 22	300	Mobile loader	10	500	150	1	0.5	0.5	3.4
10	5	Impur. at roof.....	Soft.....	*c*	...	Hand *e*.....	..	...	...	...	1.0	....	*i*
11	6–7	Impur. at btm.....	Varies.....	10 and 25	...	Hand and p.c. loaders....	..	1,000	...	...	....	....	....

a Shearing and horizontal cuts
b Special bits
c Raking is practiced
d Long face
e Pillar robbing
f Labor cost, 3.2c. per ton
g 3.86c.
h 5.02c.
i 2.8c.
j Shearing on off-shift.

HOW HIGH?
+ The Loading Cost

Reduction Yardsticks

In order that the savings shown in the case histories of cost reductions which appear in this issue of *Coal Age* may accurately reflect the achievements of progressive management, unless otherwise specifically stated in the text itself, all comparisons are based upon present wage scales. In other words, where there has been a change in wage rates since the installation of the new equipments or new methods described, current costs are matched against what the costs prior to the reduction would have been if the wage rates prior to the reduction had been the same as those now in force at the particular operation used in the case history.

BECAUSE it represents the big bulk of the operating expense in the production of bituminous coal—and anthracite also—the item of labor gets the closest of scrutiny in every cost analysis. Loading may absorb half or even more than half of the cost of production. Its place in operation is accurately drawn in a table of operating cost percentages appearing on pp. 132 and 133. This covers 32 bituminous companies in 17 states and represents approximately 40,000,000 tons of the 1931 production.

In this presentation, labor takes nowhere less than 52.46 per cent and never more than 91.10 per cent of the operating cost, the range for more than half of the cases being between 70 and 80 per cent. This same table shows that the cost of loading at the plants of the companies ranges from a low of 16.38 to a high of 56.50 per cent, the greater part of the mines showing a range of from 29 to 38 per cent.

Little wonder, then, that in applying itself to cost reduction the industry has turned first attention to the labor item, with special emphasis on loading. Of course, wages may be cut to unreasonably low levels, but there is no guarantee of permanence in this way of reducing cost. The industry would do better to seek its reductions in cost from the installation of such machinery as will aid its men in loading coal with the expenditure of less labor.

Evidence exists that efficient mechanized loading with high wages can produce coal almost half a dollar per ton cheaper than hand-loading, so long as the wages of the hand loaders are reasonable, and will do so in lesser degree as competitive wages are lower. This is substantiated by the savings made at certain mines and listed as follows:

Mine A—$0.430; wide and narrow work; a high-wage mine.

Mine B—$0.427; wide and narrow work; a high-wage mine.

Mine C—$0.200; wide work only.

Mine D—$0.150; wide and narrow work.

Mine E—$0.075; wide and narrow work.

Mine F—$0.022; wide and narrow work.

These savings are the 1931 figures of six among thirteen mines in six states operating 89 mobile loaders, all of which contributed to this study. But not only with mobile loaders can healthy economies be obtained. One company producing 35, 37 and 28 per cent of its output by mobile loaders, conveyors and pit-car loaders respectively, puts the combined saving at 41.71c. per ton. Other examples of savings reported for pit-car loaders, scrapers and conveyors follow.

An operator in a moderately low-wage field, the plant having unusually high running time and mining a quality coal sets the per-ton saving of pit-car loaders at 12.7c. Two companies fix the per-ton economy of this machine type at 33.12c. and 30.54c. per ton. Both are high-wage mines, the first working 5-ft. coal. In the second operation the cost percentages, which together total 100 are: Cutting, 2.3; drilling, shooting and explosives, 9.0; loading, 50.3; timbering and timbers, 7.4; track, 4.5; gathering to parting, 5.2; supervision, 4.0; power and supplies, not heretofore included, 11.2; yardage and deadwork, 6.1. The maintenance cost is 1.21c. per ton, and depreciation costs 10c. For these three mines the installation investment,* with machine-shift production at 35 to 38 tons, ranges from $75.20 to $85.33 per ton of daily output capacity.

Scrapers, too, are cutting operating costs. Three companies report sizable savings working scrapers on long faces. In these cases, the thickest seam effects the smallest saving; and the thinnest seam, the largest cost reduction. Thus, one installation in 6½ to 8-ft. coal gives, for 1931, a unit output per shift of 57.4c. per ton at a maintenance cost of 13c. The installation investment is $188.50 per ton of daily output capacity. A second installation, in 6-ft. coal, yielded a saving of 16c. per ton in the production of 250 tons daily from a long face. At this plant, development is by shaking conveyors which effect a saving of 20.5c. per linear foot. The percentage-cost breakdown for both types combined, on the basis of 100 per cent total, is: cutting, 5.3; drilling, 2.2; shooting, 6.8; loading, 22.0; timbering, 3.7; track, 15.2; gathering to parting, 9.9; supervision, 4.6; supplies and power, 23.6; yardage and deadwork, 6.7. The maintenance costs are 2.5c. per ton; the depreciation cost is 2c.; installation investment of $99.30 per ton of daily capacity.

In a third long-face scraper installation, operating in 39-in. coal and obtaining an output per shift of 100

*Installation investment includes one loading unit and a proration of the serving equipment (as new) required from face to parting. These serving units embrace mine cars, locomotives, cutters and drills.

to 125 tons per unit, the savings effected are 26.9c. per ton in wide work and $1 per linear foot in development. In this case the cost breakdown of 100 per cent gives: cutting, 8.8; drilling, 7.4; shooting, 8.8; loading, 32.3; timbering, 7.4; gathering (not included); supervision, 0.4; supplies and power, 30.4; yardage and deadwork, 4.5. The maintenance cost is 5c., the depreciation, 2c., and the installation investment is $79.20 per ton of daily capacity.

In 6 ft. of coal, a shaking conveyor operating in rooms has shown a saving of 13c. per ton and of 17c. per linear foot in development and an over-all per-ton saving of 30c. with a yield per shift of 75 tons. Following is the percentage-cost breakdown, total 100: cutting, 8.7; drilling, 2.9; shooting and explosives, 6.5; loading, 21.0; timbering, 3.6; track, 14.5; gathering (to tipple), 9.4; supervision, 4.3; supplies and power, 26.9; yardage and deadwork, 2.2. The maintenance cost is 2.5c. per ton; the depreciation cost, 3c.; and the installation investment per ton of capacity, $189.30.

Working two shaking conveyors in combination with one belt in a multi-room layout, and producing 102 tons per shift in 32 to 40 in. of coal, an operator figures an over-all saving of 10c. per ton. The percentage-cost breakdown, total 100, is: cutting, drilling, shooting and loading, 72.7; timbering, 3.7; track, 0.9; gathering, 5.5; supervision, 1.8; supplies and power, 11.8; yardage and deadwork, 3.6. The maintenance cost is 3c. per ton; depreciation, 5c.; and installation investment, $203 per ton of capacity.

Flight conveyors in a wide-room layout operating in a 4-ft. bed of coal bring an over-all saving of 13c. per ton to an operator on a unit production per shift of 60 to 65 tons. With a percentage-cost breakdown totaling 100, the allocation is: cutting, drilling, shooting and loading, 72.5; timbering, 2.2; track, 3.3; gathering to parting, 9.2; supervision, 2.6; supplies (not included); yardage and deadwork, 10.2. The maintenance cost, labor only, is 0.3c. a ton; the amortization period is stated as four years.

Figures for the mobile loaders before mentioned give the following cross-section of working conditions, practices and performances;

Seam thickness—5 to 20 ft.

Roof—Generally good to fair.

Room width—20 to 35 ft. usually.

Room depth—200 to 350 ft.

Entry width—12 to 16 ft., as a rule.

Places assigned to one loader—5 to 18; general practice, 6 to 10.

Partial machine loading of pillars—At 5 mines with 43 machines.

Impurities loaded with coal—At 6 mines.

Loading impurities separately—At 4 mines.

Cuts taken from each face during shift—At 10 mines, only 1; at 3 mines, 1 to 3.

Men on crew—At ten plants, 9 to

12; at each of three mines, 7, 13 and 18 respectively.

Machine-shift tonnage in wide working—High, 400; low, 180; middle group, 240 to 300 (six mines).

Advance in development per machine-shift, linear feet—High 70; low, 30; middle group, 45.

Productivity ratio, mechanical to hand—High, 3 to 1; low, 2½ to 1.

Track-mounted cutters—Used at 6 of 13 mines.

The ranges in the percentage-cost breakdown for these machines as a group, follow:

Cutting—Low, 9.3; high, 16.5; middle group, 11 to 13.

Drilling and shooting—Low 5.0; high, 16.4; middle group, 7 to 12.

Track—Low, 4.1; high, 13.1; middle group, 5 to 9.

Timbering—Low, 0.50; high, 7.7; middle group, 4 to 9.

Loading coal—Low, 11.0; high, 28.4; middle group, 10 to 14.

Gathering—Low, 7.6; high, 14.0; middle group, 9 to 12.

Supervision—Low, 2.4; high, 11.4; middle group, 3 to 6.

Yardage and deadwork—Low, 0.0; high, 2.8.

Supplies and power—Low, 16.5; high, 36.6; middle group, 29 to 32.

Maintenance cost reported for these machines ranges from 2.1c. to 7.5c. per ton, the last being for a mine which follows the practice of rebuilding the units yearly "like new." Maintenance for the middle group is 4 to 5c. Depreciation charges range from 1.9 to 10c. per ton, with the middle group at 5c. For these machines the installation investment, where the machine shift runs from 270 to 400 tons, is $79 to $109 per ton of daily capacity.

In mining, as in other industries, the profits of mechanization decline as the cost of labor diminishes, and the best interests of the industry require that this fact should not for a moment be forgotten. With the installation of a machine to supersede hand methods, the man-hours of labor required and the cost thereof naturally are reduced. But the machine at the same time adds to production cost the expense of new services and the enlargement of services already existing. The machine expenses incident to operation and the charges for capital invested must also be considered.

It has been noted that the reports on which this analysis is based show that each instance of mechanization increases one or more of the several service items. And of all phases of operation, deadwork is perhaps the only one that escapes in every case. Among the service charges increased by mechanization are those for power and materials and in some instances the charge for labor is also increased. This is particularly true of mobile and pit-car loaders, in the operation of which the greatest number of service items are increased. Both normally operate under conditions which require a minimum of deadwork.

Because with mobile loaders and pit-car loaders the charge for hand labor is replaced in part by machine and power costs, such mechanical operation is not profitable where the relatively irreducible machine cost forms too large a proportion of total cost. With a decrease in the wage rate, the profit derivable from replacing hand by machine-aided labor becomes less and less, till with extremely low wages it is wiped out by the costs inherent in mechanization. But midway between the two extremes a satisfactory profit may be anticipated.

Not unexpectedly, the three scraper records outlined in this article and the masses of other material collected for this study show that relatively greater potentialities for saving by mechanization exist in thin-seam mining. Thus the scraper installation making the biggest saving is not only working in the thinnest coal but also is in a

low-wage field, whereas others are in high-wage regions. Further supporting evidence is the appreciably higher yardage and deadwork costs, the higher loading costs and higher total labor costs in the thinner seams when compared with a representative group of the thicker. Where costs were highest in hand loading, the savings in the use of mechanical equipment will be largest, except where conditions are peculiarly unfavorable.

At another mine, flight conveyors were installed to permit mining of coal capped by a wavy roof, which at irregular intervals protruded as horsebacks in such fashion that the taking of mine cars into the rooms was impracticable, even though the coal generally was of moderate thickness. The conveyors are worked in multiple, taking coal from three, and sometimes four, rooms and delivering it at but one loading point.

By this system the direct labor cost was reduced 64.8 per cent below that for loading directly into mine cars. Including the interest, depreciation and maintenance on this equipment, and a cost of 6c. per ton for making new set-ups, a saving of 53.7 per cent yet remained. The installation investment in this case amounts to only $129.33 per ton of shift output, on a daily production of 160 tons. A determining factor in the installation of these conveyors, second in importance only to the labor saving, was the necessity for bettering the size quality of the coal, which yields little lump by ordinary methods. This desire was satisfied to the extent that 15c. per ton was added to the sales realization. It is figured that the combined savings will return the cost of the conveyors and the necessary additional equipment, including a cutting machine, in little more than a year.

Perhaps no condition is more unfavorable to the mechanization of mines than bad roof. Where it occurs it is not easy to effect any large saving. Another unfavorable condition is the occurrence of a heavy parting, or band, in the seam, whether it be of dirty coal or rock. This can be cut by machine and dumped in the gob by loading equipment, but the parting must be thick and such as would involve the employment of much hand labor if thus removed; otherwise the use of mechanical methods will not effect a saving over hand methods. As a rule, small partings in the seam penalize the use of mechanical loading methods. Such bands, however, are no deterrent to the broad economies of mechanization, particularly if the system used increases the quantity of domestic-size coal and so increases sales realization.

Many companies faced with the necessity of removing a heavy rock parting have resorted to mechanization as a means of competing with hand-loading mines. One operator mining a seam with a parting which measures nearly 3 ft. in thickness between a top bench of 4.75 ft. and a bottom bench of 3 ft., through the installation of loading machines, has succeeded in lowering his mining costs nearly 35 per cent.

Several instances of savings contributed to this study have related to the use of loading machines for the development of entries in coal between 3.5 and 4 ft. in thickness. At one of these mines about 130 tons of coal and 110 tons of rock are loaded out per shift by one machine. The men in the crew required to operate and serve this equipment, if set to loading the material by hand methods, would load less than half that tonnage, both of coal and rock. Actual money saving at this mine is about 7.5c. per ton.

Looking over the field to find further possibilities for sizable saving, machine loading of bugdust is seen looming up head and shoulders above the others. That a special type of detached machine, or one which might be added to a cutter, is an urgent need of the industry is obvious. That the need has been recognized is evidenced by the development of such equipment by one of the manufacturers. Four of these machines are now in operation at an Eastern mine. It is said that at the present stage of development the machine will remove about 80 per cent of the cuttings.

Wider preparation facilities naturally are needed when coal is loaded by machinery than when it is shoveled up by hand, because of the increased quantity of refuse that is taken up with the coal. One company reports an increase in the quantity removable from 44 to 97 lb. per ton sent to the preparation plant. This addition raised the labor-and-supply cost of preparation from 1.7c. to 5c. per ton. At another plant the increase of removable refuse, per ton as loaded underground, was 28 lb., and the labor-and-supply cost of preparation was increased 3.5c. per ton of mine output. Still a third example shows virtually the same proportion of increase of removable refuse, 0.5 to 1.0 per cent with hand and 2.5 per cent with mechanical loading. The change increased the labor-supply cost of preparation about 20 per cent.

▼ ▼ ▼

PROFIT POSSIBILITIES
In Face Preparation

(Continued from page 138)

and yet it earns its keep many times over by the convenience and speed, and accuracy of hole placement it lends to drilling.

Returns covering 236 electric coal drills gave no direct indication of profit from their use. Some companies get as much as 400 tons per shift per machine, while others obtain as little as 50, depending on whether drilling is intensified or made the part-time job of a loading crew. The tonnage figures are no criterion of the real profit accomplishment of this drill type. Its speed of operation is the determining factor and works to advantage in every case. Because of its speed, plus elimination of back-breaking labor, two or three holes are drilled where only one was drilled by hand methods for the production of a given quantity of coal. The majority of operators contributing to this study drill 5 to 9 holes into 12 to 16-ft. entry faces, and 7 to 12 holes into 21 to 30-ft. room faces. More holes, less explosive; less powder, better lump and greater safety. Two companies reported a production of nearly 10 tons per pound of explosive following this method, which is a bogey to shoot at—not to save explosive, but to improve the product and thus increase the realization.

SAFETY MEASURES + Also Pay Dividends

SAFETY not only saves lives and limbs but it also saves costs, yet some companies have barely thought of its possibilities as a cost reducer, largely because it seems commercial to drag safety from its pedestal and cheapen it by playing up its cost aspects. However, a few instances follow showing that it pays to be safe just as it pays to be thrifty. That fact has been demonstrated by several corporations. The mining law has made many a company exhaust a few of these avenues of thrift. But there are other forms of safety for which the law does not provide, and they also are profitable.

At one bituminous mine the costs for compensation, medical, and hospital expenses in 1930 were $61,570, or 8c. for every ton mined. In 1931, even though the tonnage was slightly decreased, these costs fell to $8,681, or 1.2c. per ton. This company thus earned 6.8c. per ton as the result of its safety efforts. If only the compensation costs are to be considered, they were $5,500 in 1931, or 0.73c. per ton, and in the first quarter of 1932 the compensation costs were only 0.14c. per ton. Apparently all this safety work and concentration on safety did not injure the efficiency a bit, for efficiency increased from 7.34 tons per man-day in 1930 to 9.04 tons per man-day in 1931. Not only was the number of lost-time accidents greatly reduced but their severity also, for the average cost per lost-time accident dropped from $259.79 to $140.01.

Safety studies stir up cerebrations that have a helpful effect on production. Most men need to be stirred to thought and, once done, the practice of inventive thought helps efficiency as well as safety, which, after all is said, is merely one of the many manifestations of efficiency. Every man in this mine was trained in first-aid and in the avoidance of accidents; every man became an active member in the Holmes Safety Association; monthly meetings were held at which safety was discussed; the foremen held their own monthly safety councils; every foreman gathered his men together once a week at lunch time and discussed safety; the hazard card was adopted, so that noted hazards no longer could be forgotten and be left uncorrected; protective hats reduced scalp injuries; 85 per cent of the men wore safety shoes and 100 per cent protective goggles. And these measures, discussions, and cerebrations did their work; witness the decline in the accident costs of nearly 7c. per ton.

Another bituminous mine in the same region during 1931 produced 667,600 tons and had only fourteen accidents that caused a loss of time of over two days. One chanced to be a fatal accident, something unusual at this mine. However, the compensation cost for lost-time accidents was so low that the whole cost of compensation for that year was only 1.3c. per ton.

Another mine with a fine safety organization produced over a million tons in 1931 and had a compensation cost of 0.75c. per ton. The remarkable savings possible from safety provisions can be judged from the fact that two mines in this same district that had no safety organizations had compensation costs of 7.85c. and 5.4c. per ton respectively.

But, it will be said that perhaps these low-compensation cost mines were favored by nature, so it may be well to record that a large coal company with mines in several states and several seams, typical, therefore, in everything but in its unusually efficient management, has cut its compensation, medical and hospital costs since it started its safety organization from 4.0 to 1.8c. per ton.

In the Middle West, an active division superintendent has cut his accident costs from 6.43 to 3.84c. per ton in 1931. One of his largest mines had a cost of 2.99c. per ton for that period. A large mine in the East with a fine safety organization has operated fourteen consecutive months without a lost-time accident and, therefore, had no compensation cost. And in the Far West, a large mine, as a result of organization, cut down the number of its accidents from 95 in 1930 to 21 in 1913—a saving of 78 per cent.

A company in the Far West had 443 accidents in 1924 and only 78 accidents in the fifth year following, the number of injuries decreasing steadily year by year. In the first year it had 1.656 accidents per 1,000 shifts and only 0.313 accident in the latter year. This company made the use of the protective hat compulsory, and its number of scalp injuries dropped from 62 in the first year to four in the fifth year thereafter. The number of days lost in the first year was 6,532, and in the last only 27. This same company required all men to use goggles when doing work in which eye injuries might occur, such as digging, shoveling, breaking rock, driving spikes, making hitches in rib, setting jack pipes, changing machine bits, etc. The record in 1924 showed 103 eye injuries, and in 1928 none. In the first year, 728 days were lost by reason of such injuries, and in the last year none.

At another mine, accidents to head, neck, shoulder, torso, and chest from falls of roof and coal had been reduced from 64 per annum to sixteen by the introduction of protective hats. Goggles in that mine had reduced eye accidents from 29 in 1929 to seven in 1931. Safety shoes lowered the number of accidents from 51 in 1929 to 11 in the last year.

At still another mine in the bitu-

minous regions of the East, safety goggles were introduced in January, 1929, and made compulsory for face, timber, track, and machine men when doing work requiring their use. In 1928 there were 231 lost-time accidents due to eye injuries, and in 1931 the number had fallen to 99. Accidents to the eye fell 14 per cent in the first year of their use, 12 per cent the next, and 43 per cent the next, in all about 57 per cent. More comfortable and effective goggles and instances afforded that goggles would save eyes made the reduction of accidents progressively greater year by year; for goggles began to be worn over the eyes and not on the temples or in the pocket.

At another bituminous mine, motormen, couplers and electrical repairmen all wear safety shoes, not designed to protect the feet and toes but merely to insulate their wearers from electric shocks. There were no fatalities from this cause in the year prior to their introduction, but there had been 21 lost-time accidents. In 1931 the number was reduced to 10 and there were no fatalities. Goggles were introduced in the same year, but lost-time accidents were reduced only from 9 to 8 and, unfortunately, the compensation mounted, nevertheless, from 0.04c. to 0.22c. However, only shopmen, repairmen, washery men, motormen, and couplers were required to wear them.

In this same group of mines, by the introduction of hand-loaded conveyors, compensation has been reduced from 0.92 per ton to 0.18c., almost 80 per cent—a notable reduction. Yet the percentage of quasi-mechanized loading is only 45.4 per cent of the entire tonnage. These mines have always been operated with a keen effort to promote safety. The manager was one of the leaders in the early safety movement. Consequently, when he reorganized his safety department in 1926 it was merely an effort made to get a better result than one that already had secured him leadership. This effort was made in 1926. In the year prior to that effort his compensation was 2.87c. per ton. In 1931 it was 1.22c., but 0.57c. of the betterment was due to a change in wage scale, leaving 1.08c. as a saving, which, incidentally, was the exact cost of his safety precautions per annum.

One Middle-Western company reports that it had a mine explosion which killed 15 men, and that rock-dusting saved 150 men who would have been killed if the rock dust had not been applied.

One Rocky Mountain coal company with twelve mines found that, even on an exposure basis, mechanical mining showed a margin over hand-loading of 38.3 per cent as regards fatal accidents, and a margin of 44.6 per cent over hand-loading as regards lost-time accidents. The reduction was 89.3 per cent in compensable accidents per ton, a reduction that made a notable saving in compensation costs.

One mine in Illinois, in the operations of its pit-car loaders, reduced its lost-time accidents per 100,000 tons 29.0 per cent, and its days lost per 100,000 tons 45.6 per cent, say A. C. Callen and C. M. Smith in a bulletin on "Accidents From Hand and Mechanical Loading in Some Illinois Mines." Another mine in the same region, they declare, in the operation of pit-car loaders, decreased the number of its lost-time accidents per 100,000 tons 37.6 per cent. Others showed less fortunate results, but the average for seven mines reduced lost-time accidents per 100,000 tons 15.3 per cent. However, days lost per 100,000 tons increased 26.8 per cent, showing that, to get the safety benefit from pit-car loaders, due care must be used or the results will be unfavorable.

One mine, say the same authors, using full mechanical loading, reduced all its accident records by whatever count measured, in frequency or severity per 100,000 tons, or per 100,000 man-days. At three mines studied the average reduction of lost-time accidents per 100,000 tons was 83.1 per cent, and of days lost was 74.1 per cent. In this article the question of reduction of accidents per 100,000 man-days is not at issue; therefore, let it suffice to say it is not always as reassuring as the accident record per 100,000 tons, though the instances with which mechanization improves the records based on man-days of exposure holds forth the hope that with care mechanical loading or hand loading with the help of mechanical devices may be accompanied by not only a reduction in compensation per ton produced but also a reduction in the number of accidents per 100,000 man-days of exposure.

Those who have pit-car loaders and complete mechanical loading, by studying the record of those mines which have improved their records by going to mechanical methods, can receive inspiration as to the possibility of bettering their standing. New dangers have to be faced and their causes eradicated. Many of the mechanically operated mines have been showing immense improvement, because they have given the matter careful attention and have focused the thought of their entire force on a study of these accidents. An accident really happens only once; after that it is hardly an accident; it is a piece of bad engineering, the result of lack of prevision, administration or instruction. An accident is a lesson to be learned, an indication of hazard. If it occurs again, it is because the lesson has not been learned by someone or because it has not been so studied that the hazard can be averted.

Many mines have reduced their accident records per 100,000 tons of production by mechanization. They are striving to make those records just as promising on the basis of man-days of exposure, and some have already achieved that goal. Moreover, similar studies should be made of other phases of operation regarding which little is known. Track accidents is an instance.

That safety is obtainable by protective methods is abundantly proved by the records of the U. S. Bureau of Mines. Last year one life was lost for every 306,000 tons of coal production. Five years ago, it was one for every 261,000 tons, a decrease of 14.3 per cent. As only a few mines have established any organization for safety, and as many have really only a mild consciousness of its importance, and as, moreover, many have had the safety consciousness for years and so have exhausted many of the possibilities long ago, an improvement of 14.3 per cent in five years is an achievement that proves how great a possibility exists if any one operator sets the objective before him and enlists the support of all his men. A few months should suffice to prove the truth of the assertion. Most have found large returns in the first year. The low fatality rate of European mines—British, French, German and Belgian—is further proof that diligent search for causes of accident, using the brains of every man in the company's service, can and will reduce accidents and result in a large saving in this charge—a saving that usually pays returns to every one, operator, mine worker and state alike.

Safety at the face is the greatest of all necessities because here most of the accidents occur. Safety posts

set before coal is filled will protect the men while hand loading. Long cap-pieces can be set evenly over the front-line posts, which will hold weak roof in the working lane in front of the face. Later, when another row of props has been stood, other posts can be set adjacent to the first, and these posts can then be drawn and their long caps released. Doubtless it would be profitable to use corrugated steel caps instead of wood caps, especially where machines are used and greater strength and more headroom are needed.

Systematic timbering has been found to pay. It may waste a little timber, but it takes a forest of props to pay for a single life and not a few to pay for a lost-time accident. It is good psychology to have a rule. There are many ways of turning "right about face" but only a few that assure that the turn will be made promptly and that each man in the line will end up in his proper place. "Put up a post where needed" is good advice with obviously treacherous roof, but ends in too few posts and irregularly set prop lines wherever the roof outwardly appears safe. With a definite rule, compliance with good practice changes to compliance with a rule and is subject to no question. Lastly, by the use of power prop pullers, much loss of life and limb can be avoided.

Lack of safety is one of the most expensive conditions to be found at any mine. To neglect safety is to provide for loss and bankruptcy. No better saving can be made than that which arises out of the safety of the mine workings.

Safety is a tool of management which pays dividends. That fact is perhaps not easy to substantiate by actual figures, but it is doubtless true, for the mines with the fewest accidents usually are among the most profitable, and the most unsafe mines usually are facing bankruptcy, or are well advanced in that direction.

Some may question which is cause and which effect. Is a mine profitable because it is safely conducted, or is it safely conducted because it has made the money that will finance a safety program? Perhaps, like chemical reactions that work both ways and which are indicated by arrows one above the other pointing in opposite directions, safety and economy act at times as both cause and effect; safety sometimes generates economy, and economy in its turn furnishes the fund for safety.

Safety pays because it is basically good engineering. It is order, it is system, planning, matching of means to ends, foresight. It marks the accomplishment of engineering purpose; that is, what it was purposed to do has been done. The car was to be delivered to the face in a given time and in a given condition, at a given cost. That end was attained by the absence of derailment, and of coupling, brake and wheel failures. An immense number of provisions had to be made to that end, and if the purpose is accomplished, safety, at least in a degree, follows.

The orderliness with which the end is attained, the sureness with which each purpose is accomplished, has its influence on the worker, who at such plants becomes accustomed to orderliness and becomes disposed to leave nothing to chance. The viewpoint of the worker becomes that of an engineer.

Much has been written about the foreman who thought more of the loss of a mule than of the loss of a man, but if mine workers, foremen and engineers had looked at accidents objectively, not gaging them alone by loss of life but as failures to achieve a definite engineering purpose because of certain inherent defects in planning methods, training, equipment or what not, perhaps safety work would have advanced more rapidly.

It is sometimes a question whether the cold-blooded approach of better engineering would not advance safety as much as the inspirational way which has been so greatly advocated, and which unquestionably has had a marvelously beneficial result. Safety is clearly a positive aim. "Do something" rather than "Don't do something," and doing something and doing the right thing is engineering. If a mine is unsafe, material as well as human life is destroyed.

A pile-up of cars on the road will destroy hundreds of dollars of property, take the time of several men to clean up the roadway, delay and decrease production, and make it impossible for all the tipple men to do a full day's work. Timbers may be torn down, rock may be dislodged, track torn loose, and coal lost for which payment must be made. The time of part of the supervisory force is wasted on the wreck when it should be employed on profitable work.

Well-run mines accept safety as an engineering measure. A trip should not be destroyed, or an area be allowed to cave, any more than a building should fall after construction. Derailments are accidents that destroy working schedules which have been framed not on possible accidents but on the assumption of steady operation. No one can tell what accidents cost till he has taken into account the loss resulting from equipment and loss in the effectiveness of labor.

When a foreman is asked why, on any day, his costs are unduly high, or his tonnage unduly low, he usually will reply that it was due to an accident. The answer is too often regarded as sufficient, because in too many mines it is regarded as a normal condition that accidents must happen, whereas the oversight of management, the defective discipline, the improperly constructed equipment, the uninstructed men, are not accidental but causes that can hardly fail of their effects. Managers should accept accidents as a challenge to be promptly met. Lack of safety is the outcome not of penury but of the lack of engineering skill that would make safety possible.

Not until the management of mines realizes that safety is a means of earning money to pay for equipment as much as equipment is a means of earning money to pay for safety will safety be regarded as a profit instead of merely an expenditure made to comply with a moral obligation.

MODERN METHODS + Squeeze Transportation Costs

NEXT to loading, transportation is the largest item in the operating cost at bituminous coal mines, according to the reports from individual operating companies summarized on pages 132-134 of this issue of *Coal Age*. Inspection of the figures shows that outlays for transportation range from 7 to 25 per cent. In well over half the cases, however, transportation cost falls between 10 and 20 per cent. Of the items making up transportation, labor contributes by far the most to cost and in nearly half the instances constitutes between 13 and 19 per cent of the total.

Transportation investment is a major item in plant cost also, and may conceivably reach $200,000 for a mine producing 2,000 tons per day. It is readily apparent from a consideration of these facts that transportation is a vital operating activity, and that its proper employment will influence materially not only the cost of this item but also the efficiencies of all other departments of operation.

In order that the transportation system may work at the highest possible efficiency with the minimum quantity of equipment, and in order to prevent slowing down the other operations dependent upon it, the movements of the haulage units must be coordinated with the fluctuating demands for car capacity. Dispatching offers the best means of achieving this coordination of demand and supply, and its use frequently results in worth-while savings. As an example, the experience of one 100-per cent machine loading mine in the East may be cited. This mine produces 2,200 tons per day. A six-months study made while the subject of dispatching was under consideration showed that the loading shift spent 6.5 per cent of its time in waiting for empty trips.

To eliminate as much of this waiting as possible, a telephone system was installed, and two dispatchers, one for each shift, were hired. Shortly after installation, delays due to waiting on empties were reduced to 1.5 per cent, thus increasing the daily output 120 tons. As the loaders were paid on a tonnage basis, there was no opportunity for savings in this direction, but a saving of $22 a day was made in such classifications as mine maintenance, main haulage, and tipple labor. In addition, an indirect saving of $11 per day was made in supervision, office, and mechanical maintenance labor. Deducting the dispatchers' wages leaves a net saving of $22.44 a day.

Intangible savings proved to be somewhat difficult of analysis, but the effect of increased production on the entire operating cost and on the fixed charges was conservatively estimated at $24 a day, making the total daily saving $46.44, or 2.11c. per ton. When it is considered that delays of more than 6.5 per cent frequently are reported, it can be seen that even greater possibilities of savings through dispatching exist.

While haulage equipment does the actual work of hauling coal from the face to the tipple, trackage is the backbone of the transportation system. In addition to the effect of good track on the efficiency of the haulage system, and consequently on the output of the mine, modernization of track offers opportunities for major savings in maintenance. One Eastern operation reports a reduction of 4c. in operating cost due to replacement of the main-line track, 45-lb. rail and steel and oak ties being used in each case.

Re-laying of the main-line track was only a step in a program that included the purchase of new locomotives and cars. Two main-line locomotives (13 and 15 tons) were bought to replace two old 6- and 8-ton units, and the 2½- and 3½-ton trolley gathering locomotives were replaced by 6-ton storage battery units. The new main-line locomotives haul 1,000 cars per day an average distance of one mile from the partings to the tipple, against 600 cars for the old units. The storage-battery units gather 175-200 cars per day and haul them an average distance of 900-1,000 ft. to the parting. The old locomotives gathered 30-60 cars per day.

The new cars, which are the same as the old, have the following characteristics: capacity, 2.25 tons; height, 36 in.; weight 3,700 lb., and are made of wood and equipped with roller bearings. Car turnover is 3½, and portable turnouts, each requiring 2¾ hours to lay, are used. Before revision of the track and haulage equipment, the cost of maintaining the transportation system was 12c. per ton. After improvements were com-

pleted, the cost was cut to 4-5c. per ton.

A somewhat similar revision of the haulage system at another Eastern operation cut transportation maintenance cost from 13 to 10c. per ton. Two main-line locomotives were added, and the existing gathering locomotives were changed from high- to low-speed units. The old main-line track, consisting of 45-lb. rail on 5x7-in. untreated ties, was relaid with 60-lb. rail and 6x8-in. creosoted ties. The treated ties cost $1.45 each, against 45c. each for the untreated ties with a life of four years. No figure for the life of the treated ties was set, but the indicated saving at the end of 16 years was placed at $3.40 per tie. The new main-line track cost $1,810 per 1,000 ft., and the calculated saving, including maintenance, is 0.1c. per ton.

A reduction of 0.4c. per ton in maintenance charges through the replacement of old cars was separately reported by the above company. New 102-cu.ft. solid-end, composite cars were purchased to replace the old 92-cu.ft. composite cars equipped with end-gates. Height of the new car is 37 in., the same as the old, but it is equipped with roller instead of plain bearings. Weight of the new car is 3,810 lb., against 3,230 lb. for the old car. Cost was $190, as compared to $154 for the old type.

With slow-speed motors gathering an average of 70 cars per day from an average of ten places with a maximum depth of 300 ft. and hauling them an average distance of 1,200 ft. to the partings over grades varying from 0 to 3 per cent, and with the main-line locomotives each hauling 900 cars per shift 1½ miles to the tipple, the output per loader per day was increased from 13 to 14 tons after the new cars were installed. Height above the rail in rooms and entries is 72 in. and the car turnover is 2. Maintenance cost was cut from 1.0c. per ton with the old car to 0.6c. per ton with the new car.

Comparative operating results attained at two mines of a Western company furnish a still more striking example of the possibilities of savings through car replacement. The old cars at the one mine (Mine 2 for the purposes of this presentation) are made of wood, and are equipped with an older type of roller bearing. Most of the old cars at the other operation (Mine 1) were replaced with high-capacity steel cars equipped with an improved type of roller bearing, and 80 per cent of the output of this mine is now hauled in this equipment. The two mines were selected for making the comparison because of the similarity in haulage conditions, and it was found that the total saving with the new steel cars was 2.7c. per ton. This saving includes maintenance and depreciation, and in addition reflects the savings made through increased mine efficiency. Comparative conditions of operation and results for both mines are as follows:

	Mine 1, New Steel Cars	Mine 2, Old Wood Cars
Thickness of seam, ft	4-12	5-8
Working height above rail:		
Rooms, ft	5-11	5-7
Entries, ft	6-11	6
Grades, per cent	0-2	0-3
Car capacity, tons	2.25	1.40
Weight, lb	3,000	2,000
Car height, in	44	43
Room length, ft	250	250
Average haul to parting, ft	2.000	1,000
Average loads per gathering locomotive (8 hr.)	111	160
Average haul, partings to tipple, miles	2.65	1.75
Average loads per main-line locomotive (8 hr.)	625	720
Car turnover	2.25	2.00
Tons per loader per shift	5.9	5.6
Car cost	$230	$130
Maintenance, cents per ton	0.63	1.80
Depreciation, cents per ton	2.38	2.30
Total net saving with new cars, cents per ton	2.70	.....

The above discussions of trackage savings have dealt primarily with the economies possible in laying main-line track. The following material illustrates the possibilities for savings in laying room tracks, and is abstracted from a previous issue of *Coal Age*. The operation in question, an Eastern mine, used wood ties exclusively in rooms and on main lines until the latter part of 1928. In August of that year, the first steel ties were placed in service, and a program involving the use of these ties in rooms and on main haulage track was embarked upon. The plan contemplated the laying of extensions in the rooms by the loaders, and also involved the use of standard switches laid on steel ties for rooms and breakthroughs.

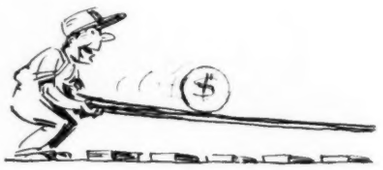
Wood ties used in the years 1927-30 were as follows: 1927, 93,000 ft.; 1928, 117,070 ft.; 1929, 33,350 ft.; 1930, 1,425 ft. Steel ties installed in each of the years were: 1927, none; 1928, 2,100; 1929, 5,960; 1930, 7,920. Cost of spikes decreased as follows: 1927, no data; 1928, $702.42; 1929, $199.98; 1930, $8.55. Total material and track labor costs for the years in question are given in the following table:

Year	Production, Tons	Total Material Cost	Total Material Cost Per Ton	Track Labor Cost	Track Labor Cost, Per Ton
1927	206,000	$3,326.90	$0.01615	$12,031.00	$0.05850
1928	308,799	5,054.52	0.01637	18,120.07	0.05868
1929	299,329	3,582.94	0.01193	14,983.49	0.05005
1930	275,498	3,219.30	0.01164	7,824.51	0.02840

On the basis of the 1928 figures, the savings in 1930 were: material, 0.463c. per ton; track labor, 3.028c. per ton; haulage (not given in the table), 0.574c. per ton. The total saving in material, track labor, and haulage was $11,998.98 in 1930.

Including indirect savings, another Western operation loading coal with conveyors reports that the replacement of old wood cars with a capacity of 1½ tons by new composite cars holding 2 tons resulted in a saving of 5.0c. per ton. The new cars, of the end-gate type, are equipped with roller bearings and weigh 2,700 lb.; the old cars had plain bearings and weighed 2,300 lb. Height of the new cars above the rail is 45 in. against 42 in. for the old car. Seam thickness varies from 5 to 7 ft.; the pitch is 6 to 7 per cent; and the working height above the rail is 4½ to 5½ ft. on the entries. Average haul to the parting is 4,000 ft., and from the parting to the tipple is 10,000 ft. Car turnover is 2½.

Production per man per day of eight hours for the different classifications did not change after installation of the new cars, standing at the following figures: loaders, 17 tons each; day men underground, 14 tons each; all men underground, 9 tons each. Cost of the new mine car was $225, against $180 for the old car. Cost of maintaining the new cars is



1.5c. per ton, as compared with 3.0c. for the old cars. Depreciation on the new cars is 5c. per ton; no figures were given for the old cars. Net direct saving with the new cars was reported to be 1.5c. per ton, and the calculated indirect saving through their use was set at 3.5c. per ton.

An increase of 75 tons per shift of eight hours in the average output of mobile loading machines was reported by a Western company which replaced its old wood cars (capacity, 3,500 lb.) with new composite cars

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POWER SAVINGS + Where to Find Them

THE summary of mine operating cost breakdown, pp. 132-134 this issue, shows that the power bill represents a substantial part of the total cost, the range being from 1.36 to 13.82 per cent and the majority falling between 6 and 9 per cent.

Many reasons might be advanced for the general yet increasing use of electric power by the coal industry, but there are two fundamental reasons: increasing use of machinery in the mines as a means of reducing cost and improvements in preparation plants.

Because electrical equipment has been installed as a way of lowering cost, it is in order first to take stock of the possibilities for extending

electrification profitably to every remaining job. Next there is the possibility of reducing the power bill by eliminating waste of electrical energy. Turning in a third direction, it is necessary to be assured that every opportunity has been taken to reduce the unit cost of the electricity consumed.

When taking stock of the possibilities for broadening the service from electricity it is important to select a proper plane or standard of complete electrification by which to judge the mine. Taking advantage of the equipment perfected and the new devices invented, it becomes practicable to apply electric power, electric signaling, electric control, electric supervision, and even "electric sight" to jobs heretofore considered in the manual class. The fact is that mechanical loading is the only major power job remaining that has not made an all-state surrender to electricity.

In the past year manufacturers of loading machines have made decided improvements toward a mechanical and electrical perfection which reduces maintenance and time lost from breakdowns to figures which can no longer stand out as valid objections to mechanization. Anti-friction bearings have been added, special steels adopted for certain parts, and the lubrication features perfected until the machine now stands as a challenge to those managements that have not undertaken the inevitable task of solving their specific problems of partings, roof control, grades, and supervision to accommodate loading equipment.

Full-automatic control of substations has grown to the point where it is a recognized common practice, yet many of the old equipments are still operating under the handicap of manual control. Employing an operative in a substation has become an indication of inefficiency, even though in a few isolated cases there may be sound reasons temporarily for the regular outpour of money to pay the operatives.

Even if a mine fan with auxiliary gasoline engine drive is located at or adjacent to an isolated substation, automatic control of proved type extended to engine starting and power switching makes it entirely practicable to dispense with an attendant, provided, in the case of a mine generating much gas, it is possible for a man to reach the fan in a few minutes by car or other means from the plant.

It is now common practice to apply full-automatic control even to substations located where a man engaged at other work near by can reach the equipment by walking as little as 25 to 50 ft. from his regular post. Power delays are reduced, better electrical and heating protection are afforded the equipment, with a consequent saving in maintenance; operating errors are eliminated; and there can be an actual labor saving by virtue of not bothering men engaged at other duties.

At a mine in the Eastern bituminous region an isolated substation located at a borehole and containing two 150-kw. converters equipped with full-automatic control has rounded out ten years of continuous and satisfactory service without an operative. It is one of the first ten full-automatic substations placed in service by the coal industry and is good for fully as many more years of use. The wage saving by virtue of the automatic control features has exceeded $12,000. Because the substation can be operated at night without incurring an expense for wages it also has saved in power cost because the mine can be supplied with power from a substation farther from the load.

A recent example of full-automatic control applied to a substation located where readily accessible to men on other jobs is at a new mine in the South. Full-automatic control was purchased to replace the manual control of a converter which was moved to the new mine from an abandoned mine on the same property. Savings by avoidance of power delays and by better protection to the equipment is earning 20 per cent on the investment.

Installation of automatic traffic signals and electric throwers for track switches, already proved as a thoroughly practical means of saving money, especially on main haulage, is deserving of rapid adoption as a common practice status in the industry. At a group of mines in the Appalachian region considerations of safety and speeded haulage alone justified an expenditure for equipping the main haulways with switch throw-

ers and automatic signals. With these equipments in service it was found practicable to dispense with brakemen on haulage locomotives. With the aid of electric switch throwers and manual traffic signals a large mine in the Middle West operates the main haulage without expense for brakemen. The main haulways in certain mines of a prominent bituminous producer in the East are completely equipped with automatic traffic signals.

A few of the other possibilities for profitable extension of electrical equipment applications are mine-door opening, better lighting, bit-sharpening machines, electric welders, automatic control of all pumps, replacing air-operated dumps with motor-driven equipments, handling and conveying equipment for mine supplies, regenerative braking on hoists and conveyors where the load overhauls the motor, electric heating where specific advantages are evident, and lifting magnets to handle rail and to remove tramp iron from coal.

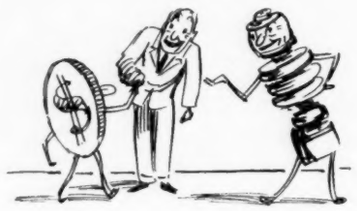
Automatic priming and control of pumps, including gathering pumps that take water through several suctions, has been so perfected that there remains little excuse for any labor expense for starting and stopping. One company operating in the East is saving $130,000 per year by an investment in automatic pumping equipment.

Operation of car dumps, skip loading gates, and the like by electricity has two distinct advantages over air operation. The power bill can be cut to a fourth or less if the compressor can be taken out of service. Compressor lubrication, and maintenance of the compressor and pipe lines are eliminated, thus effecting a further saving.

Electric heating per unit of heat delivered cannot compete with heat from open flame or from steam generated by fuels. But it does have a distinct place where fire risk is a prime consideration, where heat may be required but a few times during a winter, where automatic control of the temperature is desirable, where very small quantities of heat are required, and where heating by other methods is difficult or impossible. Just a few of the possibilities follow: Heating of offices and first-aid rooms in the mine, heating of floor plates on which men stand at a picking table and at control stations in preparation plants where a general heating system is unnecessary, heating of track switches to melt snow and ice, heating of pipes or fittings in outside pumping stations and in other places where water is used, heating of bit-sharpening and tool-tempering furnaces where control of heat to prevent damage to steel is important, and heating of the carburetor or intake manifold of standby gasoline engines.

Assuming that electric drive and control has been applied to every job where a saving is possible, it is in order to investigate every available means of reducing the energy consumption. Associated with the energy is the maximum demand, but the latter affects unit cost of power, so it will be considered later under the final heading.

Equipment methods and precautions to be considered as a means of



lowering power consumption are summarized briefly as follows: So far as possible, shut down all units of substation equipment during idle hours, disconnect power transformers during idle hours to save no-load losses, use slow-speed gathering locomotives on short hauls, maintain bonding and feeders to prevent excessive distribution losses, move substation equipment nearer to load centers, use converters instead of motor generator set unless local conditions demand the motor generator for power-factor reasons.

And continuing: Because of the higher efficiency, favor synchronous motors for large fans and pumps that operate continuously for many hours per day; if a flywheel motor generator set is used for hoisting, hold its idle running time to a minimum; maintain good power factor to reduce copper loss in a.c. lines and equipment; limit the use of electric heaters to the special jobs where it pays; in preparation plants use belt conveyors instead of "drag" conveyors; perfect lubrication methods, and favor antifriction bearings.

No attempt is made to include every power-saving kink, but there are a few others which should be included: Sectionalize mine circuits with automatic overload breakers to prevent short-circuit losses and to discourage abuses of equipment which are attended by power losses; for repair work use motor-generators instead of resistance welders; avoid the use of heavy locomotives for making trips for inspection, repair, and delivery of light material, and instead use a special light-weight self-propelling car.

Space permits elaboration on but a few additional power-saving hints. Approximate full-load efficiencies of a 150-kw. converter substation and a 150-kw. motor-generator substation are respectively 92 per cent and 86 per cent. With 24-hour operation this difference may mean a saving of several hundred dollars per year in favor of the converter. Hoists driven by d.c. motors powered through flywheel motor-generator sets are "power eaters," compared to induction motor hoists. At two comparable hoisting jobs in the Appalachian field the flywheel outfit averages 1.41 kw.-hr. per ton and the induction motor 0.72 kw.-hr. per ton. In power consumption, hoisting delays are expensive with the motor-generator equipments but cost practically nothing with induction equipment. The answer is to keep the motor-generator hoist busy every possible moment to shorten the shift hours during which the motor-generator must be operated.

An indication of the energy saving possible by a general change from drag flight conveyors, which are difficult to lubricate, to belt conveyors mounted on properly lubricated antifriction bearings is furnished by a new preparation plant in the Appalachian region. This plant, which uses belt conveyors almost exclusively and which replaced a plant of the same type and capacity that used many drag flight conveyors, requires but 80,000 kw.-hr. per month instead of double that quantity, as was the requirement of the old plant. At an energy rate of 0.5c. per kilowatt-hour, this means a saving of $400 per month.

The first consideration involved in securing electric power at the lowest unit cost is mine generated power versus purchased power. A few years ago when the sales realization and production cost of coal were not so chummy, a prominent operator who shut down his central power plant and contracted with a power company gave the following as his principal reason for the change: "I figure that our business is producing coal, not generating power." Possibly that was sufficient reason at the time, but it has no place in the close-figuring so necessary today. The low sale price of coal and the shift of certain bone

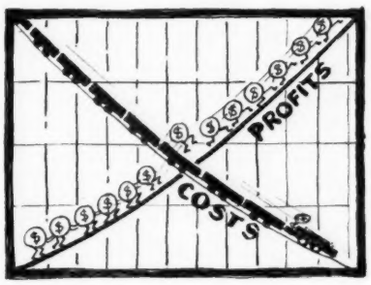
coals and grades to the unmarketable class have changed the power situation at a number of mines.

At a mine in the Middle West an investment of $34,000 in new power-plant equipment is effecting a net saving of between $1,200 and $1,300 per month and in addition is furnishing an outlet for a small but significant quantity of coal. This fuel consumed at the mine is charged to power cost at its market price. After ten years of purchased-power experience the mine load is back on the individual plant, which, however, was modernized to reduce steam consumption and maintenance and to generate alternating instead of direct current. Many companies that have continued to operate their power plants, which in a number of cases have been charged off except possibly for certain improvements, are now realizing attractive savings.

Because of choices available in rate schedules and the existence of maximum demand charges, power factor clauses and off-peak rate advantages, it is within the power of the purchaser ordinarily to effect material changes in the over-all rate per kilowatt-hour of the electrical power used. Available power-rate schedules should be investigated frequently. A new schedule may become available which will so fit a certain case as to effect a saving. Changed conditions so far as production working hours and equipment are concerned may make it advisable to switch to a rate which has existed for some time, as one of the largest producers in the Appalachian region recently elected.

By far the most important controllable factor affecting net rate is maximum demand. In the first place, if a group of mines are on one meter and these mines are operating at curtailed output, operation of the various mines should be scheduled over the six days so that the maximum power demands for each of the days are as nearly equal as possible. If a mine or several mines supplied from one meter have been shut down for a month or more and production is to be resumed it may be highly expensive to start on the date that the meters are read or a few days before. A mine in the South was put back in production one day before the regular meter reading date and the demand charge on that month's power bill was increased $1,000 over the previous month of no production. One-thousand tons of coal was loaded up to the time the meter was read. The cost of the demand portion of the power bill alone was $1 per ton.

Practically every move outlined under the heading of energy saving has its effect in reducing demand. Pumping offers one of the greatest possibilities for shifting to off-peak hours. Convenience, if it cannot be evaluated in dollars and cents, is hardly a valid reason for day-shift cutting. Where considerations of safety are involved, the whole aspect, of course, may be changed. Preparation plants, especially if of the central type handling coal received in railroad cars, may be candidates for off-peak operation. At a preparation plant in the East a change to



night operation cut $1,500 from the monthly power bill.

Demand limiters have been installed to good advantage at a large number of mines. Their practicability exists with a local condition where interruption of certain power circuits for a few minutes several times a day does not cause appreciable losses in other ways. A recent report on a demand limiter installed at a Southern mine two years ago credits the limiter with a direct net saving of $145.50 per month.

Control of haulage by a dispatcher offers an opportunity for reducing power demand. But at a large mine, unless the dispatcher is an exceptionally clever man, it may be necessary to appoint someone to make a special study of the haulage and work out a schedule for the dispatcher to follow.

A striking example of what can be done by dispatching haulage and at the same time by spreading other loads out into the "valleys" is that of a group of Eastern mines operated with purchased power. An installation of indicating and curve-drawing demand meters costing $2,100 made it possible to supervise power utilization to the extent that the total power bill is now $4,500 per month less than heretofore.

Operating mines night shift instead of day shift materially reduces power cost where the rate schedule favors off-peak loads. Several Eastern mines are so operating. Other mine owners think that the inevitable drop in labor efficiency would cancel the gain from lower power cost. A Southern mine which is limited to a three-day operating schedule loads the mine cars one day and hoists and dumps the next day, this in order to reduce the 15-minute maximum average demand.

Counted among the advantages of storage battery applications to locomotives, cutting machines and other inside equipment, is the inherent opportunity to reduce the power demand charge. A company which beat 148 others in the Appalachian field in low cost of purchased power per ton of coal mined gathers coal with battery locomotives.

Maintenance of proper power factor, of course, is of undisputed importance in reducing the unit cost of purchased power in districts where the rate schedules include a power-factor clause. Even in other districts there is not a mine that will not benefit to some extent by improving power factor. It reduces loss in a.c. lines and equipment, raises the capacity of the equipment, and improves voltage.

As an intended means of maintaining high power factor the use of synchronous motors on substation equipment is standard practice. But in numerous cases little or no advantage is derived because substation loads usually vary through a wide range and it is inherent in the power factor of a synchronous motor to vary with the load. During the last few years many companies have found it advisable to equip synchronous motor generators with automatic power factor control apparatus.

The mine fan which operates at constant load 24 hours per day is an ideal place for a synchronous motor intended for power-factor correction. Accordingly, practically every coal field now contains examples of induction motors replaced with motors of the synchronous type. Large blowers in cleaning plants and large mine pumps also are being driven by synchronous motors.

Under the head of energy saving, the converter was given preference over the motor-generator. The converter can deliver little or no power-factor correction but has the advantage that its power factor does not vary through such an extreme range with load and that the power factor moves closer to 100 per cent as

the load increases. In numerous instances the ideal combination would be to use a converter in the substation and a synchronous motor on the fan.

Static capacitors—in other words, plate condensers—have been installed as power-factor correctors in several industries, including coal mining. Apparently their field is in special cases where the synchronous motor is impractical. A coal company in the Eastern bituminous section reports that a capacitor installation made in 1931 and costing $1,800 is effecting a power saving of $110 per month.

The synchronous condenser, widely used by power companies, has found but few applications in coal mining. The additional energy that must be purchased to operate the unit must be considered carefully as a possible offset to the advantage of the power-factor correction which the equipment affords.

Over-motoring of stationary equipment is poor practice from the standpoints of power factor, energy consumption, and first cost of equipment. Instead of playing perfectly safe in selecting induction motors for a new plant it is better to keep to the lower limit even to the extent that exchanges or shifts of motors may have to be made to increase the horsepower on one or two items of the equipment. If the motors of a plant are of one standard speed, such changes are facilitated.

▼ ▼ ▼

MODERN METHODS

Squeeze Transportation Costs

(Continued from page 146)

holding 3 tons. Both cars were of the end-gate type and were equipped with roller bearings. The new car, however, was 50 in. high, against 36 in. for the old car, and weighed 3,600 lb., compared with 2,600 lb. for the old type. While the seam thickness is 18-20 ft., the working height above the rail in rooms and entries varies from 9 to 11 ft. Grades vary from 0 to 6 per cent.

Most of the coal comes from rooms driven to a maximum depth of 350 ft. Partings are kept up close to the loading sections, and the average haul from the partings to the tipple is 10,000 ft. Main-line locomotives (15-ton) handle the cars from the partings to the tipple, each averaging about 500 loads in eight hours. Gathering is done by 4-, 5-, and 6-ton cable reel locomotives, each of which handles an average of 100 cars in eight hours from six to seven places. Average number of tons cut per place is 70 in wide working and 40 in narrow places.

With the new car, the output per loading machine was increased to 275 tons in eight hours; the old output was 200 tons. The new cars cost $200 each, against $150 each for the old cars. Maintenance on the new cars is 0.84c. per ton, and the depreciation rate is 2.37c. per ton. No data on savings per ton or on maintenance and depreciation rates for the old cars were included in the report.

When a mine is working at or near capacity, interruptions in dumping may mean a delay in production, with consequent increase in production cost. In the following example, the benefit to the mine through elimination of dumping interruptions was not evaluated, the installation of an improved cager was directly responsible for a decrease of 0.393c. per ton in the operating cost through the elimination of labor. At this mine, the old center bumper cager of the automatic, spring-cushion type handled cars 12 ft. long and holding 3½ tons of coal in trips of 30. The action of the cager, in spite of the fact that it was installed to reduce labor, did not come up to expectations from either the operating or safety standpoints. When a car was released to the dump, the trip traveled a distance of 12 ft. and brought the cars to a sudden stop, frequently causing the coal to spill and thus preventing the cager from returning to the stop position. As a result, the trip of cars would be released, endangering the plant and men around the dump.

The above equipment was replaced in December, 1931, by a new cager employing the compression of atmospheric air in two cylinders to cushion the shock of stopping the trip. Trips up to 43 cars, the capacity of the loaded track on the tipple, are handled by the new cager. The cars are engaged by the cager bumper, which has a travel of 5 ft. When the car is released to the dump, the bumper drops down and returns to the stop position ready to receive the next car. Use of the new cager enabled the company to release one man per shift. Initial cost and savings in operation are given in the following table:

Cost of cager	$1,800.00
Cost of installation	300.00
Mine production, two shifts, tons	2,200
Labor savings per day (two men)	$8.64
Labor savings per month	$190.08
Savings per ton, cents	0.393

At the above rate, the investment cost will be returned in 11.04 months. As the cager has been in operation only a little over three months, maintenance figures are not available; the only expense to date has been for oil at 5c. per shift.

Where Credit Is Due

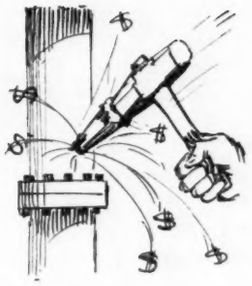
The editorial content of every issue of *Coal Age* is based upon field contacts, field study and data furnished by officials of mining companies and manufacturers whose equipment is helping coal to do a better job. No other type of content could effectively serve the needs of the industry.

Public acknowledgment of the source of material usually is given in each article. In the present issue, however, because the intimate details of costs revealed made anonymity desirable, no such public recognition of the hundreds of individuals and organizations that have so generously cooperated with the editorial staff in the preparation of the scores of case histories embodied in these pages is possible. Nameless though they must be, *Coal Age* takes this means of expressing its appreciation to all who have contributed basic data for this "Highway to Profits" Number. To them not only the editors but the industry at large is greatly indebted.

—THE EDITORS.

MAINTENANCE DOWN!

+ Make Way for Profits



WHEN new equipment is purchased, it should be expected to yield a return above a normal direct operating cost sufficient to meet three demands of sound investment. One is obsolescence, which is generally included in depreciation; another is depreciation; and the third is profit. If through carelessness, depreciation sets in at a rate which is higher than the expected amortization rate, then not only amortization but also obsolescence and profit funds are robbed of their just dues. The only assurance against such losses on capital investment is maintenance. So when equipment fails from carelessness in attendance or by reason of faults in manufacture (after the expiration of guarantees), the maintenance account suffers the penalty.

The lower limit of maintenance is the total of the lubrication and inspection costs necessary to prevent actual failures from date of installation until the equipment becomes obsolete or is no longer needed. With the best equipments now available the preventive items of lubrication and inspection can be extremely low and, therefore, in maintenance cost lies a golden opportunity for trimming the cost of coal. The possibilities have been demonstrated by a large producer in the Appalachian field which cut total maintenance cost from 18c. per ton to 8c. in the last three years.

Reduction and control of maintenance is an operating problem next in importance to the supervision of labor. This is the creed that has been followed by companies that have been most successful in reduction of equipment maintenance. The whittling from 18c. to 8c. was effected after officials elevated the problem to its proper operating level and visioned the advantages of improving or replacing defective or misapplied machinery.

Whether maintenance is 6c. per ton or 40c. per ton—the first perhaps at a mine with ideal natural conditions and the latter where nature showed little consideration for the coal operator—in either case, the figure is too high. Repeated failure, the underlying reason for the bulk of maintenance cost, has no place in the new standard of industrial efficiency.

Wear, breakage, corrosion of metals, and rotting of wood cover practicaily all items of equipment failure. Broadly speaking, all are preventable during the normal life of equipment. The big problem is to minimize the wear on surfaces subjected to abusive service as on mining machine bits, locomotive tires, and on pipe, chute or screen surfaces over which water or materials glide.

Substation equipment and electric driven fans should have maintenance costs so small that it is not practical to follow them up on a per-ton basis. Mechanical preparation plant maintenance costs vary so widely with the methods followed and with the types and extent of equipment that it is impractical to offer a bogey or average figure.

An outstanding instance of reduced maintenance by virtue of better main haulage locomotives is to be found in the northern Appalachian region. An investment of $45,000 for new locomotives of characteristics well suited to the service and equipped with antifriction bearings and other devices to reduce maintenance will be returned by the savings in less than four years. Two cents per ton is the saving in maintenance and operating cost by virtue of this equipment which replaced the older and misapplied main haulage locomotives.

At a Southern mine blowers added to the motors of three main haulage locomotives saved in one year $2,200 in armature repair cost. The total investment was but $1,800. Another company applied thermostats and circuit breakers to its locomotives and thereby eliminated the roasting of armatures. The direct saving per year is well over 100 per cent on the investment.

Filling locomotive tires by automatic electric welding apparatus is showing handsome returns. One of these welding heads costing $1,200 and in use at the central shop of a Northern bituminous company filled 158 tires in 1931, thereby effecting a saving of $3,460. The average total cost of filling a tire is $9.60, as compared to a cost of $31.50 each for a new tire.

By welding and machining mechanical parts in an intelligent reconditioning process, one large operator in 1931 succeeded in saving $139,000 or 1.3c. per ton, at a cost of about $22,000. The steam chest carrying the valve seats for a 2,500-kw. turbine was badly steam cut, and the leaks were so great that speed control at no load could not be maintained. New, the chest would have cost $1,590, against a cost of only $34.67 for reconditioning, or a saving of $1,555.33. A quill gear costing $85 was repaired at a cost of $14; a loading machine crank disk costing $50 was reconditioned for $2.40; a cutting machine main frame, original cost $205, was welded up at a cost of $21.98.

Armature repair and ball-bearing renewal costs on locomotives may offer savings opportunities to those companies which have not heretofore dug deeply into these details. The same holds true for the armatures and ball bearings on mining machines and on other inside equipment. A company in the Appalachian field saved $30,000 in one year by using higher class coils and getting better jobs on armature repairs. Another large producer is now mining 90,000 tons of coal per ball-bearing renewal on mining machines and locomotives, as compared to 33,000 tons three

years ago. Purchase of higher grade bearings and exercise of greater care in installation and lubrication enter into this increase in bearing performance.

Mining-machine maintenance cost should include bit replacements and sharpenings. Providing better voltage in the working places, perfecting lubrication, and adopting the use of special or treated bits usually are the avenues of easiest access to reduced maintenance. New machines equipped with better motors, better bearings, improved bearing seals and lubrication facilities, better controllers, and using higher grade materials and gears will of course materially reduce the electrical and mechanical maintenance.

By tipping bits with one of the several hard materials now available a number of producers have reduced the maintenance of the machine proper 30 to 50 per cent and cut the power cost of coal cutting by as much as a fifth. Entire cutter bits made of super alloys such as silico-manganese and tungsten-carbide offer possibilities for coal cutting.

The use of special alloy steels to replace parts structurally weak on certain types of equipment built some years ago offers an opportunity to practically eliminate recurrence of breakage. At a Southern mine, certain armature shafts lasted less than a year. Nearly six years ago, the shafts were replaced with ones made from the toughest alloy steel available, and none has broken since. The investment in the installation of improved shafts has saved more than 100 per cent per year. Grinding shafts to a smoother surface and fitting bearings with less play materially increases bearing life.

Tool steel in specially designed gears and pinions cost appreciably more than common types, but they are worth it, the experience of a number of operators indicates. One company, by adopting these for use in all of its gathering locomotives of 6½ mile speed under full load, in a gear reduction of 4 to 1, has been saving 25 per cent of earlier replacement cost in material alone, to say nothing of the savings in labor of replacement and delays to operation. This same company installed a tool-steel gear and pinion as a replacement of a herringbone type train on an air compressor. The latter gears lasted an average of only 60 days. The super parts show no appreciable wear after six years of operation.

Proper lubrication of preparation plant equipment is an important factor in maintenance cost. Automatic lubrication of all bearings from central supply tanks saves labor and does an immeasurably better job. An investment of $4,500 for automatic lubrication at a 300-ton-per-hour combination wet-and-dry plant in the South is saving 0.77c. per ton in labor, power, and lubricant. In addition there is accruing a saving in repair cost and another from avoidance of operating delays.

Inclusion of more anti-friction bearings in the designs of improved equipment, provision for convenient and thorough lubrication, and use of inclosed electrical equipment are features that are reducing the maintenance of modern loading machines to a third or less of the average figure of a few years ago. The use of a lubricating truck equipped with oil and grease tanks and with high-pressure pumps has been an important factor in reducing loading-machine maintenance.

It is not unusual for mine-car maintenance, including lubrication, to run over 1.5c. per ton if the cars are of wood and are equipped with inferior bearings. Up-to-date figures from a large mine in the Appalachian field show a maintenance cost of 0.5c. per ton for an equipment of modern steel cars. The average cost had been 1.5c. per ton with the wood cars that were discarded. Commercial type mine-car lubricating machines are reducing the lubrication item of mine-car maintenance to a notable degree.

Reciprocating pumps of the old type without provision for adequate oiling have no place in the present scheme. Substitution of the modern type of self-oiling reciprocating pump for gathering duty cuts wear maintenance to an insignificant figure. Self-priming centrifugal pumps for gathering duty have also proved practically free of wear maintenance cost.

Corrosion from acid water is still responsible for the major part of pump maintenance cost in certain districts. In numerous instances available bronze or steel alloys far superior in lasting quality to the materials in use, could be substituted. The labor item of the cost required to renew parts becomes more significant as maintenance in general is reduced at mines. The higher first cost of parts made from superior materials becomes a lesser consideration.

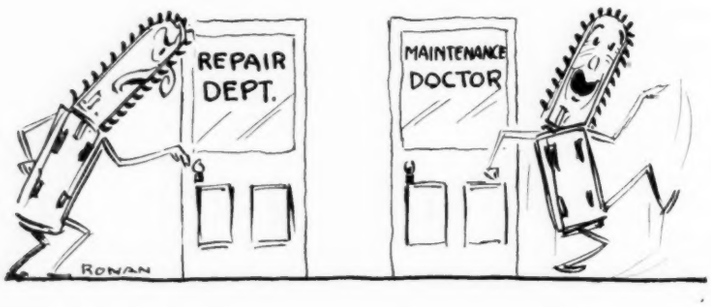
A large company operating in thin seams in the Appalachian region has developed several policies and methods which save in the use and maintenance of pumps. All pumps purchased are of acid-resisting materials. Preference is given to single-stage pumps, which are arranged in series or parallel for the flexibility demanded. As the extension of workings is rapid, at few of the mines is it feasible to install central pumping stations. Taking advantage of great variations in cover, dams are installed and pumps moved to stations under least cover, dependence being placed on suction head to reduce total lifts.

The mine waters are highly acid, so that impellers chosen are of bronze. They are given several protective coats of boiled linseed oil and red lead, which paint is said to check corrosion materially. Experience at these mines has proved the merit of steel or iron composition for sleeves and spacing rings.

At these same mines ball bearings have been substituted for sleeve bearings on the shafts of 15-hp. motors driving eight reciprocating conveyor heads; also on pump motors of 3-10 hp. Making this change cost about three times the cost of the ball bearings. The original end-frame is merely welded up and rebored to take the ball bearing. Prior to this improvement, at least one of the conveyors was in need of repairing or armature winding once a week. Now repairs are required at intervals of months. Serviceability of the pumps has been similarly improved.

It was stated that substation and electrically driven fan equipments should have maintenance costs so low as to make it impractical to check them on a per-ton basis. Both fans

(Turn to page 157)



HOW VENTILATION COSTS + Can Be Reduced With Profit

VENTILATION economies have not received the consideration from mine operators to which they are entitled. Many of the fans in use are of the disk type with blades of sheet metal. These fans are not suited to the high water gages which are needed for the ventilation of large mines, being too light for operation at high speeds. Others again are of dimensions not suited to the mines which they have to ventilate, being either too large or too small. For this reason they are highly inefficient, no matter how excellent they may be in themselves as ventilation-producing mechanisms.

With all the power consumers boarding at a common table on the power from the power house, it rarely happens that the operator knows just what any one consumer is taking from the entire power bill; all he knows definitely is that the fan is one of the most voracious of the consumers and one of the steadiest. The hoist at a shaft runs hardly at all on Sundays, on holidays, or at night, but the fan runs for the full 24 hours of every day, rarely at any speed reduction.

It is this fact that is challenging the attention of the coal operator and engineer. It is not alone the power of the motor, it is its unending grind, hour in and hour out, day in day out, week in week out; whether the mine works or is idle, that makes economy of operation of the fan a most essential item. A unit that works a few minutes in the hour, or a few hours of the day, may be inefficient without much harm being done; but a fan which works 8,760 hours in a year needs careful scanning, as does also the mine that has to carry the ventilation which the operation of the fan sets in motion. If the fan makes more air than the mine will take at a given water gage, that air does not go into the mine but backs up against the fan, merely wasting power by creating resistance to the flow of air from the blades.

Air coming from a blower fan in a horizontal direction at many mines has to be turned and passed down a shaft. In making this turn, the air tends to travel straight ahead as if the turn were not there. If it strikes a square corner, turbulence is sure to result. Even when that corner is replaced by a curve, the tendency of all the air is to travel as far as it can toward the rounded corner. Not all the air will reach the outer curve but, nevertheless, whether it actually reaches it or fails to do so, the great mass of it will be found near that surface and but little of it near the inner angle. As a result, the air, instead of being distributed over the entire cross-section, is found in part at a high pressure and traveling near the curved surface, and in part at a lower pressure and merely idling near the inner angle.

At one coal mine, the turbulence due to a rectangular turn has been corrected by placing vanes at the top of the shaft, each of which takes a horizontal scale of air as it reaches the curve and conducts it to a similar vertical position in the shaft. It also brings the air to such a position as to make corrections for the difference in cross-section of the shaft and fan drift. Thus, the air makes the turn without loss of its velocity head. This is important, because, at high speeds, that head accounts for a large part of the horsepower of the air.

When a large air current has to be taken through such a small airway as is provided by a shaft, a fan drift or a single heading, it should be carefully protected against turbulence. A smaller quantity of air traveling at low velocity can be twisted and turned through rough and crooked aircourses without the immense loss sustained when the air is traveling at express speed.

In drift mines, where the resistance is often low, the air usually does not have to negotiate the turns which have to be made in shaft mines, where the resistance is high. At the foot of the shaft, some companies have placed vanes to direct air to the headings. Unfortunately, none of the mines that have made these improvements have made studies to determine just what savings have thus accrued, but one unfortunate result has been experienced by those who installed vanes at the foot of the shaft. As the shaft was wet, the coldness of the intake air during the winter caused icicles to form which fell down on the vanes, collapsing them.

It would seem that where such cold air has to be passed down a shaft, it should be warmed so that icicles will not form. Several mines which have no such vanes, however, have found that warming of intake air pays, because it prevents not only the formation of icicles, which restrict the passage of air, but also the freezing of water behind shaft linings and in the roof, which causes rapid deterioration and even entire destruction of both.

Many companies make provision at a point quite near the shaft for the dividing of currents among the many headings that ultimately carry it, the air being distributed from an airway of generous cross-section running obliquely to the entry headings which debouch into it. The air current should never be carried a long distance before being thus divided, though consideration must be given to the possibility that it may be necessary to construct an overcast to pass over a cross-heading, a difficulty that can be better surmounted—if it cannot be avoided—in a single entry than in several.

Should the air have to negotiate

sharp turns in an airway carrying large volumes of air traveling at high speed, at least one vane should be provided so as to keep each vertical scale of air from interfering with other scales and causing turbulence.

The means for making the air negotiate sharp turns without excessive resistance are either venturi bends or vanes. A venturi bend is a bulge on the side of the heading on the intake side of the turn, which reduces the cross-section of the airway. This bulge is located on the side of the heading on which the turn is made.

With one such bend, the U. S. Bureau of Mines has found that with a velocity of 900 ft. per minute, the resistance of the bend will be equivalent to only 131 ft. of straight, unobstructed heading, whereas with square corners the loss will be equivalent to 257 ft., almost twice as much. In another experiment the resistance with the venturi bend was equivalent to only 114 ft. of straight airway. These distances seem trivial compared with the total distance, often miles, that the air has to travel. Its importance lies in the high velocity at which the air is traveling at this part of its course, a speed so great that it should be reduced in as short a distance as possible.

Vanes give an even better result than venturi bends. With a square turn, as stated, and a velocity of 900 ft. per minute the resistance is equivalent to that of 257 ft. of straight, unobstructed heading, whereas with a single vane of 9-ft. radius and the corners rounded so that the outer radius is 15 ft. and the inner radius of the turn is 6 ft., the equivalent length of straight unobstructed heading is reduced to 49 ft. These figures are taken from Bulletin No. 285 of the U. S. Bureau of Mines. Unfortunately, no results are given for higher velocities, such as are often found in mines.

Important savings can be effected by having the fan fit the mine. As already explained, at a given water gage only a certain quantity of air will travel through a given aircourse, depending on the resistance of the airways, due to their size and condition, just as the pressure of water on a pipe will drive only a certain quantity of water through it. Important savings can be made sometimes by shifting fans to such mines as have conditions to which they are adapted; that is, as an ideal, each mine will be served by a fan which will give the quantity of air the mine requires at the exact water gage that will enable the air to pass through the mine in that volume.

Twelve fans, at as many mines, operated by one anthracite company, had mechanical efficiencies ranging from 18.8 to 77 per cent. If a fan well suited to the mine had been provided at the first of these mines, the cost of power would have been divided by four. It would pay well to make such a provision, though in few cases are the fans so badly proportioned to the job at hand that such a large saving could be obtained.

Recently attention has been called to the possibility of improving all centrifugal fans by the use of vanes within the fan casing. In the original centrifugal fans, the air was held between the casing and the blades till each blade in turn reached a point of release, at which point the air was allowed to escape with a sudden puff, which naturally caused vibration. Later it was realized that this was a mistake, and the scroll casing was devised, which was gradually increased in capacity in proportion to the quantity of air seeking to be released from the blades.

Yet no attention was paid to the fact that the air would not be evenly distributed over the area provided but would be under greatest pressure and have the greatest speed at the surface of the scroll casing. By providing successive internal scrolls, or vanes, to retain the air delivered over each part of a revolution of the fan, the air delivered has been much more evenly distributed over the cross-section of the outlet. No longer does most of it emerge at the lip and none of it from the other side of the outlet. These internal scrolls have been termed "turbulence eliminators."

One company in the Appalachian bituminous region has been making a careful study of all its fans. It obtained at one mine 81,400 cu.ft. of air with a water gage of 3 in., whereas before only 69,000 cu.ft. had been obtained with a water gage of 2.4 in. Normally that increased volume of air would have required a water gage of 3.34 in. instead of 3 in., and the horsepower would have had to be increased 64 per cent instead of only 30 per cent, which was the increase actually obtained. This improvement was made not with vanes but with a change in the opening, which was raised so as to enable the air to leave the fan without negotiating the sharp angle of nearly 150 deg. which formerly had been provided. That angle was by the new construction reduced to only about 30 deg., and, with the new outlet, more of the air was delivered direct to the discharge instead of being directed at the scroll, where it was necessary to divert it at a large angle.

In another fan, vanes were introduced. As a result the fan, which had been passing 82,000 cu.ft. of air with a water gage of 3.2 in., thereafter delivered 96,000 with a water gage of only 3.125 in. The efficiency was increased 14.1 per cent. This fan would have given the required volume of air without any change except in speed of rotation, but at an increased cost for power of $3,600 a year. With corresponding results, two other fans were similarly equipped. In all, the savings made by the company were $14,400 a year, and this at a comparatively small expenditure.

Thus convinced that the fans were not as economical as they should be, experiments were made to improve the flaring outlets of one of the fans. An *évasé*, or flaring stack, was built 16 ft. high, expanding at an angle of 12 deg. It was supported by guys. This outlet increased the volume of air 8.9 per cent and demanded an increase of power of only 2 per cent instead of 29 per cent, which would have been needed if it had been designed to get that increased volume by increasing the fan speed. It is interesting to recall that the flaring outlets of all European fans are much higher than those used in America, and that the anthracite region, under the European influence, which obtained throughout its earlier ventilation construction work, built relatively high chimneys to its fans, and doubtless is profiting greatly by that fact. In this connection, it is interesting to note that of 638 fans operating in the anthracite region in 1928, 308 were of a type invented by a Belgian engineer over 80 years ago, in which, however, some small changes were incorporated.

To return, however, to the mechanical engineer of the company already mentioned, he writes that he is inclined to the belief that it may take as much power to pass the air through the fan as it does to pass it through the mine, and that fans need as much improvement as mine airways. He has found that by reducing the clearance between the wheel and the casing, he has been able to increase the flow of air in one case from 45,000 to 48,000 cu.ft. per minute, and, in another case, from 96,000 to 102,000 cu.ft. per minute,

with no additional power consumed in the operation of the fan. In one case, after he had erected a suitable chimney, inserted vanes (turbulence eliminators), added clearance rings to eliminate recirculation, and provided a modified venturi tube entrance, the air flow was increased 16 per cent with no increase of power, yet the airways were considerably extended in the period during which the several changes were made. Here again is a power saving of 56 per cent.

New types of fans have been introduced which have given good results in practice. These embody propellers of different types mounted at a single point or at several points along a shaft. In one case the propeller consists of two sturdy webs on either side of the shaft, these webs having a variable pitch. The air comes to all these fans in the same direction in which it leaves. The idea is to provide a straight flow line for the air, and these fans measurably achieve that result. Thus the disk fan, greatly modified, has adapted itself to the needs of the large mine. One of these fans at a Western metal mine has a capacity of 300,000 cu.ft. per minute and a water gage of 9.8 in. This fan is set in the narrow part of a venturi or *vena contracta* passage. This fan has only two webs, or blades. All the propeller fans have the advantage of ready reversal, inexpensive installation, and relative portability.

Estimates of ventilation on cost sheets usually are defective. In general, any heading that is not serving as a roadway was, from the first, constructed for the sole purpose of carrying air, and every crosscut is temporarily an air passage, though for a while it may serve as a roadway, but that road is itself usually laid merely for the construction of another airway. In most mines, many more roads are driven solely for air than are driven for the dual purpose of transport and ventilation. In cost accounting also, construction of overcasts is generally thrown in as a deadwork item. Ventilation, therefore, finds an important place under the head "Yardage and Deadwork." Airways, again, often have to be timbered. "Timbering," therefore, is frequently a "Ventilating" item. In mines which have a bad roof, and in which the miners prop their own rooms, the support of airways forms an important part of the "Timbering" item.

As the rock which falls in airways has to be handled and often loaded, brought out and dumped, ventilation charges are to be found hidden in both "Transportation" and "Other Direct Charges." The "Power" item of ventilation is most important, yet it is lost among the costs of other power used. In the item "Supervising and Engineering" lurk still other ventilation costs, which, for all these reasons, are larger than credited on any cost sheet.

It is important, for these reasons, that ventilation efficiency be provided. Some costs, of course, cannot be avoided, because a return airway for air must always be provided, but with care in design the number of airways, or the power bill, can be decreased or better ventilation afforded with the same number of airways and the same power. In one mine the cost for ventilation is $150 per day for power alone and $100 for construction and maintenance. At another mine, a hand-loading operation, the cost of ventilation is 12¾ per cent of the entire operating cost; this includes labor, supplies and power, nearly 9½ per cent being for the last item. In this case, apparently, the allocation of costs to ventilation is more complete than in other cases, and an unusual effort is made to render doubly sure the purpose that gas explosions shall never occur.

In conclusion, it may be said that in the ventilation of mines as a unit large economies are available to the mine operator, either by (1) improvements underground, (2) the use of fans that fit the demands of the mine to be ventilated, (3) the reconstruction of fans to reduce turbulence, recirculation within the fan and outlet and inlet losses, and (4) the purchase of fans of a new type. To these means of economy may be added long intake ducts or lofty *évasés* so arranged as to prevent air which leaves the mine by the outlet being sucked back again into the intake where intake and return are situated near each other. Where there is such a recirculation, the air circulated in the mine may contain, at its entry, carbon dioxide, or even methane. Quality of air circulated is more important than volume.

Auxiliary ventilation is a further possibility in cost reduction, making it feasible to drive crosscuts between headings at greater intervals and yet with assured and positive ventilation. It also makes it possible to omit the use of curtains on roadways, which otherwise may have to be used to deflect the air into rooms. These curtains create much resistance, interfere with haulage, and give ineffective ventilation at all times, with delays in clearing powder smoke. They also have caused accidents to men on trips and constitute a fire risk if dry and made of flammable material.

At a mine in the Appalachian bituminous area it was found that with auxiliary ventilation, using fabric tubes and blowers with crosscuts at 240 ft. centers, a 2,000-ft. entry was driven in 134 days, whereas with brattice cloth 160 days was needed. In the one case, seven crosscuts were driven through the entry pillar, and in the other 24. Because the coal was only 39 in. thick, and space was needed to pass air behind the brattice, it was found that headings driven with brattice cloth as a ventilating provision needed 20 ft. of width, whereas headings driven with auxiliary ventilation required only 16 ft.

But overlooking all the costs in heading and crosscut driving and considering only ventilation, concrete-stopping costs, power and propping, the driving of the entry with auxiliary ventilation cost $767.24, and the entry with brattice cloth $1,417.92, a saving with the former of $650.68, or 45.9 per cent. The figures include depreciation, interest, maintenance, and repair. It is estimated that the equipment used for a full year of 300 days would save $1,456, but with normal running it should save at least $1,000 annually. As the fan and tubing cost about $400, the profit is at least 160 per cent per year, with the saving in crosscut driving as an added sweetener.

GETTING BUSINESS + By Modern Preparation

THE marketing advantage flowing out of the ability to satisfy consumer demand for coal that will give greater efficiency is the motive back of the installation of modern coal preparation facilities. In part, the stricter requirements have been set up by the consumer, who naturally is interested in the cost-saving and convenience factors of well-prepared coal, but this trend has been accelerated by the coal producer, who is pointing out to the consumer the advantages of a better prepared product. Installation of modern preparation facilities therefore is, to a considerable extent, an exception to the general rules governing revisions of mining methods and purchase of new equipment for cost reductions. It seems evident that in the majority of cases the operator who installs new preparation facilities is guided primarily by the possible competitive advantages. Cost reduction for its own sake apparently is a minor factor, as the operator is willing to sacrifice this, if necessary, for the increased production and running time made possible by the preference of the consumer for better-than-average preparation.

With the growth in the number of new preparation plants in the last few years, cumulative experience has shown that in the majority of cases such installations are repaid in increased business. Coupled with the fact that the expenditures for labor, supplies, and power in preparation comprise a comparatively small percentage of the operating cost dollar (pages 132-134 of this issue of *Coal Age*), the return in good will, wider markets, and consumer preference on an investment in modern preparation facilities easily stands comparison with any other step toward reduced operating costs or increased sales.

Examination of the list of contracts let in the past three or four years for new plants or facilities reveals the important place that modern preparation holds in the thinking of the industry. Many examples of the present standing of preparation might be cited, but the following are typical. The first concerns the experience of an Eastern company which found that in spite of the excellent qualifications of the coal from one of the seams it operated, it could not enter the byproduct coking market because of an excessive quantity of ash. Installation of a cleaning plant enabled this company to sell the coal from this particular seam for making byproduct coke, with an immediate increase in output.

Another Eastern company coked its product in beehive ovens for the foundry-coke market. When foundry operators adopted new specifications, the company found that its product would not be acceptable. After extensive research, mechanical cleaning was adopted, with the result that the coke produced was in every way equal to or better than byproduct coke for foundry use. A third Eastern commercial producer was able, until last year, to reach only the steam and domestic markets. A mechanical cleaning plant was installed, and in addition to a worth-while increase in sales to existing markets, the company found that the cleaned coal was suitable for use in byproduct coking, due to reduction in sulphur and ash. The company also reported that it was able to get a premium on its cleaned coal without much difficulty.

Considering labor, maintenance, and supplies, one large Eastern plant which began to clean 80 per cent of its product last year was able to show a reduction of 1.4c. per ton in preparation cost through the installation of mechanical cleaning. In this case, the major saving came through the elimination of hand-picking, though this was in part offset by increased maintenance, supply, and power costs. While the coal produced by this plant was inherently unsuitable for coking, the company reported that the cleaned product met such a favorable reception that the mine was able to operate a greater percentage of the available working time than any other operation in the district after the cleaner was installed.

Striking evidence of increased running time through installation of mechanical cleaning is embodied in the experience of an Eastern plant cleaning the minus 4-in. coal, or 70 per cent of its product. This mine was able to operate 243 days in 1930, against an average of 189 days for all operations in the same county. The company stated that the cleaned coal was easier to sell in the present competitive market, and that it was able to enter new markets and reach new classes of consumers.

An actual reduction of 1c. per ton in preparation cost was reported by an Eastern company cleaning its 2x½-in. coal mechanically. Production of the mine is 1,400 tons per day, and the 2x½-in. coal comprises 20 per cent of the total. After the cleaner was installed, the preparation cost was cut to 7c. per ton, including 0.5c. per ton for reject; preparation cost prior to the installation of the cleaner was 8c. per ton. The old plant employed eight men and operated 11 hours per day; the number of employees was increased to ten when cleaning facilities were installed, but the hours per shift were reduced to nine. The cleaned coal, the company reported, was easier to sell, and was able to enter new markets, with the result that sales were increased. The plant was not in operation in 1930, so comparative figures on running are not available.

Like the above plant, another Eastern operation found that cleaning the smaller coal (1¼-in. slack) made it easier to sell, with the result that it was able to retain present customers and make some progress to-

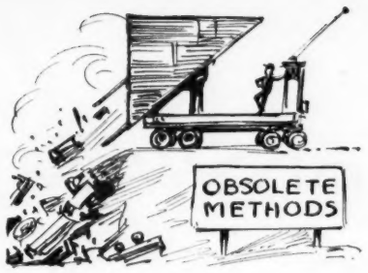
ward increasing sales. Cleaning cost was reported to be 8c. per ton, of which 4c. per ton was chargeable to reject. One man is employed in the cleaning plant, which operated 210 days in 1930, against an average of 206 days for all the mines in the same county.

The East is as yet the stronghold of mechanical cleaning, but the experience of companies in other districts that have adopted this method of preparation closely parallels that of Eastern operators. As an example, a Middle Western company reports that the radical change in its market demands which accompanied the onslaught of the present depression made a change in preparation necessary. By the installation of crushing facilities late in 1930 to cope with conditions peculiar to the coal and to meet the increased demand for screenings, the mine was able to operate up to the middle of last year without the loss of a day, when a mechanical cleaning plant was installed to prepare the 3x0-in. coal. Since that time, the mine has operated at full capacity every day, and its product is reported to be more firmly intrenched in the good graces of customers than ever.

"Dustless" treatment of domestic sizes has grown steadily in the past few years in response to the demands of householders for a product that is not objectionable to handle. This has resulted in a material increase in the installation of treating equipment at the mines, as well as at retail yards. Although there is some division of opinion among operators as to whether dustless treatment should be applied at the mines or at the dealers' yards, it is significant that out of 34 companies which reported treating equipment at the mines, 50 per cent made these installations in the last two years.

All operators replying to an inquiry by the *Coal Age* market research staff reported that ability to supply treated coal was an effective sales argument, particularly where dealers have not installed their own equipment. Also, with a few exceptions, the companies reported a premium of 25c. per ton on treated coal; the cost of treating, in most cases, was set at 10-12c. per ton. In only one instance was the coal sold without a premium. A number of operating companies have exploited their preparedness to furnish treated coal through sales promotion plans and advertising, and report a resultant marked competitive advantage.

Refuse disposal, a byproduct of



mining and preparing coal, is a problem of more or less magnitude at the majority of bituminous plants. As the disposal question is largely an instance of a necessary evil, it quite frequently has not received the same attention as other mining operations when the problem of cutting cost comes up. That opportunities for worth-while savings exist, however, is shown by the experience of an Eastern company which revised its disposal system some time ago and thereby cuts its costs 0.8c. per ton. Drop-bottom cars are employed, and before the system was revised it was necessary to build dumps from time to time to receive slate and other mine refuse. In addition, a mule-drawn side-dump car was used to dispose of the tipple refuse.

The principal feature of the new disposal system is a 500-ton bin built in the tipple. Refuse is now brought out in the regular motor trips, and is dumped into the bin, which also receives the tipple reject. A 5-ton electric slate larry was purchased for wasting the refuse on the dump. Two men now operate the disposal system, replacing the crew of five previously employed. The quantity handled per hour is now 60 tons, against 30 tons with the old system, and the average haul to the dump is 1,000 ft., double the old distance of 500 ft. Cost of refuse disposal was cut from 1.1c. to 0.3c. per ton, and, in addition, the sizable item of building slate dumps from time to time was eliminated.

Installation of an aerial tram at another Eastern mine reduced the number of men employed in refuse disposal from 10 to 1. No information on the old method of disposal was received in this case, nor were comparative cost figures given. The quantity wasted, however, was given as 40 tons per hour with both the old and new systems, while the distance to the dump over the aerial tram is 2,500 ft., against 3,000 ft. with the old system.

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MAINTENANCE DOWN!
Make Way for Profits

(Continued from page 152)

and substations are of such vital importance that the most reliable equipments available should be used and the installation made in a most thorough manner. When thus installed, maintenance cost need amount to no more than the cost of a few minutes' inspection once a week or once a month plus the cost of a small quantity of oil added at intervals—perhaps months apart. Such has been the experience of a prominent company operating mines in several districts. Full-automatic control and protection equipment is practically a requisite to insure this trouble-free operation.

At few mines is the maintenance of equipment handled so efficiently that the management should be complacent, yet in methods alone is not where the real opportunity exists. Regardless of how well the repair job is handled, an equipment which is inherently faulty will fail again. Outstanding accomplishments in reducing maintenance have been due in the largest measure to investments in new, improved equipment and in improved parts for existing equipment.

Worried with a high maintenance cost, one company in 1924 instituted a system of "life-history" records to cover the maintenance of every piece of machinery. After repairs are completed a report is forwarded to the office covering each item of supplies, its cost, and the cost of labor. These are entered on cards as a permanent record. The system tells what parts require most frequent replacement and further serves as a check on the man in charge of any machine in question. Records show that the supply cost of this company is now but two-fifths of what it was in 1924, though loading methods have since been turned into a mechanical operation.

WHAT'S MY ANSWER + To These 78 Questions?

COSTS must go down! In what directions lie the greatest opportunities both for quick reductions and for less immediate changes which will yield dividend savings over a long period of time? What are the road markers on the Highway to Profits?

The seventy-eight questions which follow are suggestive of the way in which many progressive operators have found the answer to their problems. Individual executives, with their intimate knowledge of the special conditions facing their own companies, will experience no difficulty in further extending the list.

1. How much study has been made of scientific management in a general application to management control, covering such details as job analysis, planning, forecasting, etc.?

2. Have forecasts been made of important phases of operation so as to explore the road ahead and make provisions now for the future?

3. Has modernization been made a policy of continuing improvements so that advantage is taken of savings immediately?

4. Are variable and constant items of cost closely calculated and analyzed?

5. Has an inventory of cost-reduction possibilities ever been made?

6. Has an analysis been made of production costs under varying percentages of plant capacity as an aid to setting prices during off-peak seasons?

7. Are costs and production records adequate for intelligent guidance of management, both in operation and in selling?

8. Are records too involved in red tape and detail?

9. Are records made only to be filed away and forgotten, or are they analyzed currently and utilized as management's sharpest weapon?

10. Has the problem of concentrating working sections to increase the efficiency of mining operations and transportation been considered?

11. Is the ultimate being achieved in coal recovery underground without increase of operating costs?

12. Has the rule that no work should be done manually that could be done mechanically (within the limits, of course, of the economic and human factors) been constantly applied?

13. Have time studies been considered as a means of increasing efficiency?

14. Is the equipment you are using satisfactorily suited to the job?

15. Has equipment been studied with an eye to eliminating the increased cost resulting from wear and obsolescence?

16. Frequently there are more money leaks during the night shift than during the day. Has the organization and functioning of this working force been put under the magnifying glass and analyzed?

17. Is an attitude prevalent on idle days of letting things take care of themselves?

18. Has responsibility been properly divided as a means of eliminating red tape, bickering, and confusion?

19. Is the foreman required to make out a daily report as a record of conditions and a spur to his initiative?

20. Has a system of selecting employees with an eye to fitting them to specific tasks been considered?

21. Have the possibilities of slow-speed gathering as a factor in saving power and lessening maintenance costs been exhausted?

22. Have time studies been made to determine whether main-line locomotives might haul more coal in eight hours with trips of 25 cars, for instance, than with trips of 50 cars?

23. If dispatching is a practice, do the duties of the dispatcher include control of peak electrical loads by temporarily delaying heavy trips?

24. Is time being wasted, day labor sacrificed, armatures burned out, excessive sand used, and tires worn off trying to haul all a locomotive can possibly move over its route?

25. Has each motorman or dispatcher been instructed as to the maximum number of cars the former is expected to haul?

26. If steel ties are not used exclusively on main-line track, are they being used at intervals to prevent spreading of rails?

27. Has the steel mine tie been thoroughly investigated and tried under local conditions?

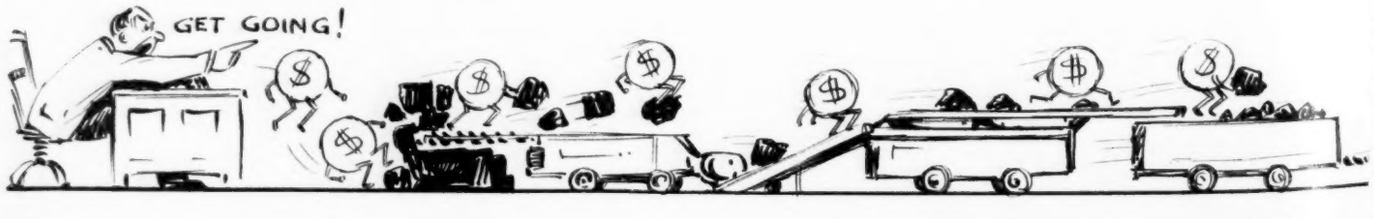
28. In many cases new mine cars have paid for themselves in one or two years. Has this economy been fully investigated?

29. Are your mine locomotives under-motored, indicating obsolete equipment?

30. Have the possibilities of preservative treatment of timbers and ties on main entries been investigated?

31. Have you investigated savings in use of track-mounted cutting machines?

32. Has the question of a more economical type of cutter bit been considered?



33. Have blasting methods and materials been considered with an eye to economy and the production of more coarse coal?

34. What precautions have been taken to maintain uniform methods and practices in blasting, the best having been determined?

35. Has the economy of power drills for putting in shotholes been tested?

36. Have ventilation studies of the mine been made and periodic surveys continued as a method of guaranteeing the most efficient ventilation at the least cost?

37. Has any study been made as to economies that might be affected by sinking a ventilation shaft either to give better ventilation or lower operating cost?

38. Has an inquiry been made as to whether the fan being used at a mine operates efficiently at the water gage needed to supply the mine with the air it needs, and what it would cost to move another fan there or purchase a new fan with suitable characteristics and possibly a better design?

39. Do you know how much power your fans are using?

40. Do you know which split causes you to use so much power and how much it would cost to reduce the resistance of that split?

41. Have you studied the advantage of providing a shaft to take care of the necessities of this troublesome split?

42. Where timber rots quickly, by reason of the bad air passing through the roadways, has any study been made of the possibility of converting all the returns into intakes by providing a shaft so that return of the air will not be necessary?

43. Has sufficient attention been given to leaky stoppings?

44. Are your doors and stoppings set firmly in the ribs and roof so as to prevent leakage, with the roof and ribs gunited to prevent the bypassing of air?

45. Is the plant large enough to warrant the use of a rock-loading machine to clean out airways, or does the company have a sufficient number of small mines to transfer the machine from one plant to another?

46. Is an attempt made to keep equipment constantly in good repair and thus to avoid breakdowns and delays?

47. Has there been installed a system of "life-history" records covering equipments, their maintenance, and repair costs?

48. Have maintenance and inspections been systematized?

49. Has an analysis been made of repair records to show which jobs recur most frequently, or which machine parts give the most trouble, with a view toward correcting these troubles?

50. Has lubrication control been neglected to the point where lubricants are wasted by dousing at one time, followed by a long period during which no lubrication at all is applied?

51. Are your locomotive wheels kept up to a certain standard by welding at suitable times?

52. Has the coverage of various materials per dollar invested been fully explored—paints, metals, etc.?

53. Has any study been made to determine which materials and supplies are most frequently needed, and which of these might more profitably be stored underground, thus saving steps and time in deliveries, and also providing that certain supplies will be handled in large lots rather than piecemeal?

54. Have the opportunities of better distribution of supplies during the day been fully studied?

55. Has a system been evolved to prevent day and night bosses from duplicating each other's orders for supplies?

56. Has a system been devised to control the supplies inventory?

57. Has a supply routing system been devised?

58. Does the amount of construction work on hand suggest the economy of using precast concrete blocks made right at the block?

59. Have you considered the possibilities of power generation at the plant?

60. Have load centers been definitely determined, and are substations moved regularly to these points?

61. Has any move been made to schedule the starting of the larger equipment with a view to lowering peak demands?

62. Has thought been given to high-tension distribution of power below ground, and to the use of converting equipment at the load center?

63. Is bonding checked monthly.

64. Have you studied your accidents from the standpoint of human behavior and made a psychological approach to betterment?

65. Do you keep a detailed cost account of accidents and safety?

66. Is employment contingent upon physical examination, so that compensation will not be paid for injuries sustained at a date earlier than at present employment?

67. Have safety shoes, protective hats, and goggles been introduced to minimize accidents and compensation?

68. Have you thought of the possibility of saving lives and limbs, props and material, and of recovering a larger percentage of coal with a reduced percentage of slack by using a power prop puller that will bring out a row of props at one time instead of drawing them one at a time by a light prop puller, or similar equipment?

69. Have all possibilities of better preparation been exhausted?

70. Has research been made to determine the critical zones in the mine-run product—the portions which contribute most impurities to the total product?

71. Have the economics of coal recovery from tipple refuse been fully investigated?

72. Have present losses to bank and degradation in washing been studied with a view to putting in a type of machinery that will reduce such losses?

73. If coal is crushed, has the operation been studied with an eye to minimum yield of fines?

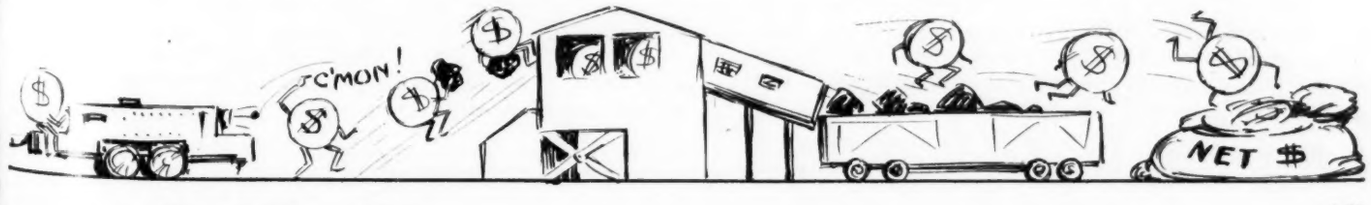
74. Are your labor costs in cleaning coal excessive?

75. Have the possibilities of selective mining been probed?

76. Does the sales department base its sales program on what the mine can do in the way of sizes and costs, or are losses sustained by working backward?

77. Have you given service on combustion problems to hold customers?

78. Have you considered briquetting of fines?



COAL AGE

SYDNEY A. HALE, *Editor*

NEW YORK, APRIL, 1932

Cincinnati and costs

NEXT MONTH Cincinnati again becomes the Mecca of coal operating officials interested—and these days who isn't—in reducing costs of production. The program of the Ninth Annual Convention of Practical Coal Operating Men and National Exposition of Coal Mining Equipment, to be held May 2-6 under the auspices of the American Mining Congress, revolves around this theme. Always a live subject, conditions at the present time have made it still closer to the industry's thinking.

On to Cincinnati!

Waiting for the check

SEEING that safety pays well, why do managers of well-conducted mines object so strenuously to the lack of safety provisions at competitive operations? Perhaps because they know that they will have to pay their own scores and that the other mines, run on a shoestring, are not likely any longer to be at the table when the fateful time arrives at which the due slip is presented. This illustration may be pressed far, for in the event that all the companies are insured by a common agency, those that remain to receive their slips may have to pay not only their own but that of the "company" whose coat tails have been seen passing nonchalantly through the revolving door.

Kindly complaisance by inspectors in allowing companies of slender means to work their mines hazardously is questionable benevolence to the men thus working, to other operators, to the insurers of such properties, or even to the company itself, for hazard is a costly indulgence where graduated compensation rates have to be paid whether graded by existent uncorrected hazards or by record of accidents to date. It would be a more considerate act to make it impossible for any operator, however badly pressed by his creditors, to avoid toeing the line of safety.

If the extra expense did close his operation, the coal would come from some other mine, and just as many workmen find employment as before. If it did not, the provision of safety would spare the operator many costly expenditures for compensation, and in the end save him money, unless indeed his purpose was to avoid meeting his bill by a timely bankruptcy should a major accident suddenly end his chance-taking.

Prices and progress

THE present relation between prices on the different sizes of bituminous coal is giving rise to fervent complaints in a number of regions, particularly where mine-run coal is being displaced from its former position of supremacy. These growing pains are, however, but the latest manifestation of a trend that has been steadily developing in the last few years, though their severity has been aggravated in the current industrial depression by demands for steam sizes at times when the domestic market was prevailingly weak.

A better balance between the traditional steam and domestic sizes may be expected with the return of prosperity, but good times will not banish the growing demand for smaller coal for industry or limit the call for finer sizes that results from the increasing installation of stokers and other improved domestic and commercial heating equipment. Producers, as is lately the case in certain fields, may deplore the growth of screening, with its consequent increased production of smaller sizes, but the problem of a decline in realization through adherence to the time-honored methods of fixing relative prices is still to be met. There is no stopping of the trend toward smaller sizes, even if the industry wished it so; capitalizing on the trend points inevitably to a revision of price relations.

Common ground

OBSOLESCENCE in either methods or equipment is never a more deadly drag upon net earnings than during periods of depression. In flush times, the plant which is not completely modernized may be able to absorb the cost of obsolescence by shrinking its profit margin, but when selling prices are beaten down to levels which permit only the most efficient to market at a profit, the obsolescence tax becomes greater than can be borne. Industry then faces the alternative of deciding whether it shall continue to spend solely to produce or whether it shall also spend to save.

Because some coal operators have been adding little or nothing to capital expenditures for new equipment in recent years, it has become a commonplace to say that the industry is spending no money. And yet, in 1931 with production distinctly subnormal, the coal industry "spent" over $750,000,000 exclusive of capital investments. How much of that not inconsiderable sum might have been "saved" if more money had been diverted to expenditures which would reduce costs and give definite promise of profits? The preceding pages of this issue show conclusively that there is no phase of the operating cycle where modernization will not cut costs and increase efficiency.

Coal producers and the manufacturers of coal-

mining equipment should find a common ground in the attack upon this problem. As was stated in a booklet entitled "Let's Stop Selling Equipment," distributed recently by *Coal Age* among the manufacturing group, the industry is not interested in buying equipment as so many pounds of iron and steel. But the industry is very much interested in spending to save, in buying net profits—for that is the road to financial salvation. "Those mines at which we made the largest capital expenditures last year," declares the vice-president of a large producing organization, "showed the greatest reductions in cost." Even the banker who is worried about the frozen state of the coal paper in his vaults might well ponder on this.

That strange light

"VITRAIN bands, in ordinary banded bituminous house coal," says M. C. Stokes, "affect a photographic plate in the dark so as to imprint themselves as a clear image upon it." Others declare that the methane from a marsh forms a strange dancing light known as the *ignis fatuus,* and it is said that mules can find their way in the dark of a coal mine. Yet no light can be seen emanating from a tube of methane. Can it be that vitrain and marshes do not emit methane but an unknown polymer or polymers of it that turn to methane only after release, generating a faint light in the process?

Another cause for this belief is the large quantity of methane emitted or created by a mass of coal when the latter is liberated from the coal seam, a quantity much greater than can be explained by the volume of the coal from which the so-called methane is emitted and the pressures at which it is known to exist. Perhaps also natural-gas deposits are not mainly of methane but of the polymer of methane, such gas having a greater molecular weight than the more stable gas and probably more readily subject to ignition. This might explain the readiness with which gas at the face is ignited by coal cutters and picks. Such gases might be expected to be most prevalent where the coal contains excessive quantities of gas and where the gas is under such high pressure as to cause bumps.

Still in danger

ALTHOUGH Representative Douglas, of Arizona, recanted after the House had passed his amendment further reducing appropriations for the Bureau of Mines (*Coal Age,* Vol. 37, p. 121), the economic service of the Bureau is still in jeopardy. Acting on protests from the mineral industries, the Senate Committee on Appropriations restored an item of $48,000 stricken out under the Douglas amendment. Later, however, the bill was returned to the committee by the Senate with instructions to report back a measure carrying appropriations 10 per cent less than the total in the original House bill.

The original House bill appropriated approximately $275,000 for the economic work of the Bureau in coal and seventy other minerals. Even a 10 per cent cut in this item would be questionable. If, however, the Douglas cut is to stand and another 10 per cent is to be shaved off the reduced appropriation, the situation will be tragic from the standpoint of service to the mineral industries. In so far as service to coal is involved, it would mean that the weekly coal report, the monthly coke report, stock and consumption studies, and all surveys on distribution and marketing would go by the board.

What the coal industry needs is more, not less, of this service which is covering a field where statistical information on current movements is at the best scattered and imperfect. Mineral industries, which made their voices heard in the attack on the Douglas brand of berserk economizing, should be equally prompt in presenting their views to the Senate.

When pillars are removed

IN many anthracite mines, pillars are removed scientifically with due care to leave no stumps of coal behind and to obtain a break line reasonably straight and long enough that the fractures will extend to the surface and relieve the weight. As a result, squeezes are avoided, coal is saved, and men's lives are not jeopardized.

But this care is not always taken. In fact, observation seems to show that pillaring in the anthracite region has quite frequently been rather promiscuous and that break lines are rarely preserved. The coal and floor in that region are hard and furnish excellent support, but that only makes the danger greater when stumps are left. The roof also is strong, but with greater strength comes a greater resistance to breakage and a heavier load on the pillar before breakage occurs.

Worse, however, is the fact that the seams are not level. There is, therefore, a tendency of the pillars to overturn — a difficulty less frequently found with bituminous coal roofs. When the equilibrium is destroyed by the failure over a large area, the pillars are badly twisted by roof movement, and that movement produces a dynamic rather than a static stress.

As a result, squeezes are far from unknown, and when they occur they are sudden and their results severe. There are, however, enough examples of good practice in the anthracite region to give assurance that pillaring methods in general will be improved, affording greater safety and better coal extraction. With all the mine broken up into old and fractured pillars, and several seams mined one above another, untoward accidents are liable to occur if care is not taken to provide scientific pillaring and to work the pillars back from boundaries or outcrops.

THE BOSSES TALK IT OVER

Rehabilitating the Injured

As the foreman started out the office door, the superintendent called him. "Mac! That man Brown, who lost an eye, was just in and said he was ready to return to work if you have a place for him."

"Why not?" inquired the foreman.

"But what if he loses his other eye or is otherwise injured? Can we afford to take the chance? Permanent disability is a big burden on our compensation account."

"That's right, but what else can we do? Didn't he lose his eye here? Certainly we can't bar him; nor can we shoot him as we did the horse that broke a leg last week."

"Then you feel that every industry should be compelled by law to take care of its injured?"

"Absolutely, Jim. No other legal measure would drive home deeper the responsibility of industry for the safety of its workers."

WHAT ARE YOUR VIEWS?

1. Should rehabilitation be saddled on the individual company?

2. How does your company handle the problem?

3. If the man alone is responsible for his injury, does that fact alter the decision?

4. In what way might the company make him self-sustaining without giving him a mine job?

All superintendents, foremen, electrical and mechanical men are urged to discuss these questions. Acceptable letters will be paid for

Can a waste elimination program be definitely planned? The bosses took up this question in March. What the readers think is told in the letters following:

Let the Shop Foreman Decide

With profit returns from the use of machine tools so inviting and good machinists so available, every mine, large or small, should have a machine shop and a modern welding outfit. The shop should be just large enough to handle the work at the mine, and be located to keep down handling charges and for convenience of supervisory forces. With a shop at the mine, no metal of any kind should be considered junk until the machine shop foreman had passed on it. There must be some system of requisitioning supplies either from the shop or from the supply room. A good plan is to require an old part delivered to the shop before a new part is taken out. In this way the shop foreman will have every piece of work pass through his hands and will be able to decide what replacements should be made or what parts saved.

To keep up interest, it is well to have the shop make a charge on every item it turns out and check this against new parts. In some cases a good mine shop will turn out pieces at a cost for labor and materials 50 to 75 per cent less than new parts would cost. The actual cost should be charged the department using the shop-made part. No parts should be bought until the shop foreman has seen the requisition and made his bid on making up the parts—and the bid should include other items besides labor and material.

It will open the boss' eyes when he sees how much waste can be eliminated in this way. Mine-car wheels can be repaired; small shafts turned out of broken car axles; worm armature bearings refilled and bored; and gears rebuilt when a few teeth are broken out. All of this will eliminate waste. A wide-awake shop foreman should be able to make a nice showing at almost any mine today, as most plants are operating machinery for cutting and hauling, if not for loading coal.

Elimination of waste of oil is a big job in itself and one that can't be given too close attention. An efficient way to check up (and this in itself will help to eliminate waste) is to give each machine that uses oil a number and a container suitable for carrying oil without spillage. Each time this container is brought to the oil room for refilling, a charge should be made against this number; and each month the master mechanic or some designated person should check the quantity of oil used by each machine. If the quantity used is excessive, the machine on which it was used should be examined and the cause corrected at once.

There are so many outlets for waste around a coal mine that it takes constant fighting to keep out of the red. But if intelligent ideas are presented to the men by the operating foreman, it is easy to get them to guard against waste. A close check should be made on all small items that go underground, such as spikes, nails, bolts, nuts, small track plates and cap pieces.

Every man should have a picture constantly before him of what can be accomplished by elimination of waste in supplies and labor. It is well to have a display board near the mine shaft and thereon show the supplies that may come over the tipple with the coal. Then, the men will know that the higher officials have their eyes on this waste of material. OSTEL BULLOCK.

Central City, Ky.

Tackle the Big Items First

It certainly looks alluring to have a method worked out to eliminate waste systematically. And if somebody could find a well-laid-out plan to attack the sources of possible waste, it surely would be a great help. There is only one item to be weighed seriously before making such a plan. It is to consider the special conditions of the plant for which it is worked out. It might seem like carrying steel to Pittsburgh or coal down the shaft to drive home the importance of running a plant with the greatest possible efficiency. But let's remember that everyone in a responsible position who is working hard on his problems looks at the problem in his own personal way. Conditions vary.

If I give here my system of waste attack it should therefore not be a suggestion that somebody else might profitably copy it. But in thinking about a problem the methods of the other fellow might lead us to new ideas.

I keep a rigid account of all expenses. At the end of every month, I go over every item, compare its figure with the preceding months, follow everything up which seems exceptionally high, and study carefully the operation whose costs are high enough to be of first importance. Study the biggest items first. If I can cut 10 per cent on an item which comprises 10 per cent of the total cost, I save 1 per cent of the total. Saving 10 per cent on an item which comprises 1 per cent of the total, means only 0.1 per cent of the total. The biggest items are the most important ones, and systematic studies should start there.

With the smaller items, I follow a different method. There are 100 little things. It is impossible always to follow every bolt. When we give out a light bulb when a broken one is turned in, are we sure where the broken one comes from? Strict bookkeeping and an occasional hit and miss investigation keeps up the spirit and the idea that every penny counts. On ten 1 per cent items as much can be saved as on one 10 per cent item.

What is a small item and what a big one? That is not easy to say. It would be nice if we could study every item, large or small. But this might lead us to organization in which the efficiency work is costlier than the savings.

Whatever is done to reduce or eliminate waste, one idea is universal and should govern every system and every plan: to make a better product for less money. EDWARD PROSTEL.

Dickinson, N. D.

Where Shall We Look for Waste?

Many mine officials concentrate on the salvaging of rails, ties, spikes, and timbers, and call it a perfect day. They have skimmed to the dead line in oil and grease consumption to achieve the maximum saving of oil and bearings—big items, of course—and are satisfied with their work. They replace loose and worn rail bonds, as promptly as possible. But does the average official continue to plan effectively on waste elimination of material, power, and labor? Organizing a well-defined, all-embracing program of waste elimination to include every man and step in the operation of the mine is the right start. Get all of your stuff on paper. It will be a most profitable manual.

The manual may well begin at the working face, in a search all over the mine to get the maximum coal with minimum trackwork, power and haulage cost. Efficient timbering, being an important factor of safety as well as the greatest insurance against the loss of coal and track, the timber itself will not figure largely in your salvaging program if mining is by room and pillar. In saving the track and recovering the maximum quantity of coal the timber has performed its office. It usually is crushed, broken, or it is recovered only at great cost and risk.

The greatest savings in timber are made by intelligent choice of size, quality and strength. The costly hit-or-miss practice of giving some miners too much timber and others none should be remedied.

Handling and distribution of supplies must be planned to prevent all waste of supplies and labor, and especially unnecessary labor in the future rehandling of such supplies. All material should be placed on the job before the job is started. More time and labor are wasted looking or waiting for missing material than from any other one item in mine work.

Next consider wasted power. Perhaps that should be considered first. A constant gnawing into profits follows oversight of wasted power. This waste takes its toll in every phase of mining, from the working face to the power plant. Electric power is wasted not only in broken returns but also in poorly insulated wiring. It is wasted on dirty roads and wet rails, on overloads and underloads. It is wasted on inefficient pumping. It can be wasted wherever it is applied.

When your manual is compiled and going, everybody will bear some of the responsibility of preventing waste—the trackman and the motorman, the timberman, bratticeman, pumper, as well as the bosses. And it will be only through them and their full appreciation of the responsibilities that the mine executives—that Jim and Mac—will be successful in eliminating in the fullest measure all waste in coal mining.

Davis, W. Va. W. H. NOONE.

Speak Softly; Carry a Stick

In the maintenance of discipline methods vary. One boss will get results by his method and another whose method is quite different may, nevertheless, obtain equally effective results. This is so probably because neither one is sufficiently psychic to vary his tactics of approach sufficiently to suit the differing types of human mind with which he has to deal. Some men respond to kind and patient instruction; others regard a boss employing such methods as soft and ineffective. One thing is sure: the hard-worked mine boss, with the multitude of responsibilities with which he is burdened, should not be expected to study the individual temperaments of the men under him as if they were a bevy of temperamental prima donnas.

However, the boss who recognizes and values the good will of his employees should endeavor to steer a course which will impress the men with the fairness and impartiality of his conduct but which will, at the same time, tolerate no disregard of his orders. In the words of the immortal "Teddy," he should speak softly and carry a big stick. Through all the ages the most successful leaders of men have been those whose personalities were positive. A certain measure of ego is a necessary accompaniment. Such a personality often carries its accomplishment to a successful conclusion through sheer will power. Some such quality is necessary in a boss if he is to be respected and obeyed. To the degree with which this quality is mingled with intelligence and fair dealing depends his ability to organize and direct the human charges under his supervision.

WALTER E. BUSS.

Vincennes, Ind.

Publications Received

Requests for U. S. Bureau of Mines, and Department of Commerce publications should be sent to Superintendent of Documents, Government Printing Office, Washington, D. C., accompanied by cash or money order; stamps and personal checks not accepted.

Fuel and Power in Latin America, by J. R. Bradley. Bureau of Foreign and Domestic Commerce, Washington, D. C. Trade Promotion Series, No. 126. Price, 25c.; 129 pp., map.

Relationship Between Oxidizability and Composition of Coal, by Wilfrid Francis and H. M. Morris. Bureau of Mines, Washington, D. C. Price, 10c. Bulletin 340; 44 pp., illustrated. Report covering work done under a cooperative agreement between the U. S. Bureau of Mines, Safety in Mines Research Board (Great Britain), and Carnegie Institute of Technology.

Agglutinating, Coking, and By-Product Tests of Coals From Pierce County, Washington, by C. M. Marshall and B. M. Bird. Bureau of Mines, Washington, D. C. Price, 10c. Bulletin 336; 31 pp., illustrated Investigations by Pacific Coke & Coal Co. in cooperation with U. S. Bureau of Mines and University of Washington.

OPERATING IDEAS

From Production, Electrical and Mechanical Men

Storing of Coal by Portable Conveyors Increases Slack-Time Running

AT Dehue mine of the Youngstown Mines Corporation, located in Logan County, West Virginia, run-of-mine coal has been stocked by a system of portable belt conveyors extending from the tipple direct to the stockpile. The simplicity of this system and its flexibility, by reason of the portability of the conveyors, suggest a wide opportunity for the adaptation of the idea to the handling of refuse from a preparation plant and stowing it on near-by banks, as well as for handling coal.

One 60-ft. conveyor is installed in a semi-permanent manner to carry the coal overhead directly from the tipple and across a track. From its discharge chute a series of portable units convey the coal to the pile. The belt conveyor at the tipple is a duplicate of the conveyors on two 60-ft. stacking units. All are Barber-Greene 24-in. units operating at belt speeds of 350 ft. per minute, and these handle the coal at a rate of 220 tons per hour.

The view Fig. 1 was made from the top of a pile which was stacked in a manner similar to the set-up that appears in the background. All but two of the full equipment of conveyors are included in this halftone. The total is ten—seven 45-ft. and three 60-ft. With this equipment a pile with a radius of about 435 ft. could be stacked. At Dehue, however, space limits the pile to a rectangular area much narrower than the semicircle otherwise possible to cover.

Drive equipments of the conveyors consist of Westinghouse 1,750-r.p.m. ball-bearing line-start motors wound for 220 volts a.c. and connected to the head pulley by a reduction gear and roller chain. Safety switches are used, and the wiring is in rigid conduit. Connections between conveyors are made by rubber cables fitted with receptacle plugs of a rugged outdoor type.

Fig. 2 shows a 60-ft. stacking conveyor piling to its limit of about 22½ ft. By placing another stacking conveyor on top of the pile a second layer could be stacked, but this has not been done at Dehue.

Byproduct coal from the Eagle seam is the material being stocked. The plan has allowed operating the mine two to three days per week through the winter, thus preserving the organization and giving employment.

Fig. 1—200 Tons Per Hour Direct From Tipple to Stockpile

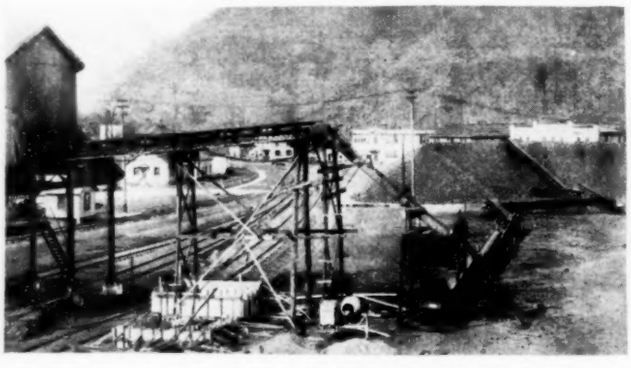


Fig. 2—Stacking a 22-Ft. Layer

Cleaning Generator Armature With Carbon Tetrachloride

Cleaning d.c. motors and generators with compressed air is not a bad practice if there is no oil mixed with the dirt and dust, for air will not remove oil. A field coil can be replaced or repaired cheaply, but not so the armature windings; so it pays to keep them clean.

Often it is difficult to discover how oil gets into the windings. Sometimes a poorly designed bearing will lose oil, and the latter find its way into the armature. But another cause, and one little suspected, are oil vapors in the room, sometimes from a leaky stuffing box, or when the lubricator is being blown out. These vapors are drawn into the armature by the suction created in its revolving.

A satisfactory method to clean an armature properly is described by John

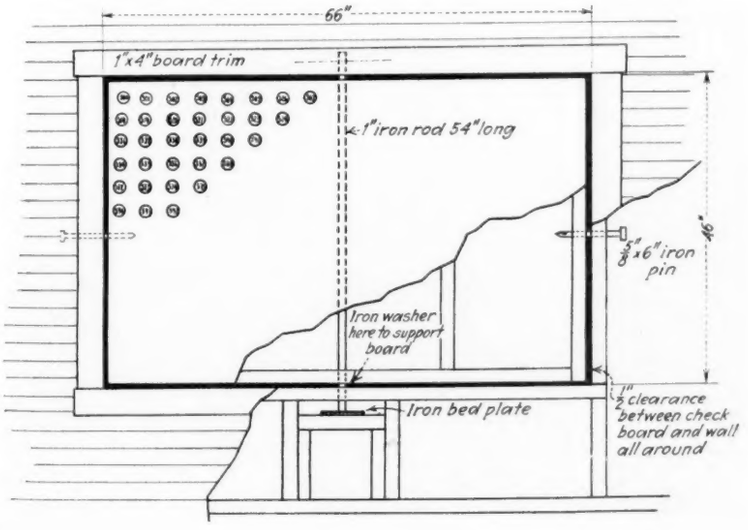
Nolan, Terre Haute, Ind., as follows: Secure a metal tank of, say, 10 to 20 gal. capacity that will safely carry 20 lb. of air and connect a small hose with a nozzle having about a ⅛-in. opening to the bottom of the tank. Put about five gallons of carbon tetrachloride, a quantity sufficient to clean the armature on the average generator. This chemical is inflammable, a good solvent for oil and dirt, and costs about $7.75 wholesale. Place a piece of oilcloth between the armature and lower field coils to carry off the dirty liquid. Direct the stream on the windings about one-third way up, using very little pressure. If you find that the liquid evaporates on the coils instead of dripping off at or near bottom, direct the steam lower, or increase the flow. Revolve the armature slowly by hand toward the person who is operating the nozzle, and do not attempt to force the liquid out in the form of a spray, as it will then evaporate quickly and do no good.

Swinging Car-Check Board Saves Time

At the Kayu mine of the Koppers Coal Co., Coxton, Ky., time and temper of the weighmaster and tipple crew are saved by a swinging checkboard. Formerly it was necessary to transfer car checks twice: first from a small weighboard hung near the scales to a larger checkboard in the weighroom, and again at the end of the shift, from the weighroom board to an outdoor board accessible to the miners. Now, writes D. D. Jenkins, only the first transfer is made, because after the bulletin is checked it is easy to pull back the two iron pins shown in the drawing and swing the checkboard around ready for the next day's run.

Both sides of the board are numbered and provided with check hooks. The two iron pins referred to above serve to secure the board in a closed position, making it almost an integral part of the wall around it.

Can Be Swung Inside Out



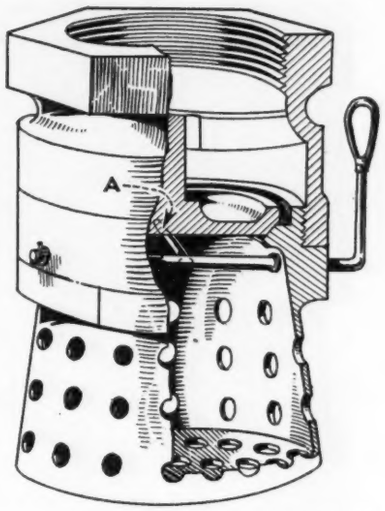
Saving Pennies

Most of the European churches and cathedrals with beauty to awe the searchers for art are not works which were built from the wealth of nobles. Generally, it was the "butter-denial" pittances of laboring peasants that erected those glorious edifices. In modern times fortune upon fortune has been built from nickels and pennies. The individual or organization that sneers at lowly copper will have little chance to smile upon nickel, silver, or gold. Our present descent from an overinflated prosperity balloon can be charged as much to utter disregard of little economies as to extravagant big spending. The majority of the operating ideas in these pages are suggestive of savings. For the most part, the savings do not bulk large, and so will hold little interest to those who talk big money. But it is a gratifying commentary on thrift that those companies that have dollars are saving pennies. Their plants are plastered with operating ideas suggested by or taken from these pages. Are you proud of the pennies you are saving? If so, send in your ideas. *Coal Age* pays dollars for those "penny" ideas.

Lift Shaft in Foot Valve Empties Centrifugal Pump

At strip mines, in cold weather drainage pumps must be emptied of water with each shutdown in order to avoid damage from freezing. This job is rather unhandy if centrifugal pumps are used, for it involves disconnecting the hose.

A way round this problem in the draining of an 8-in. centrifugal pump was found by Roy Ault at the Elkville (Ill.) stripping of the Truax-Traer Coal Co. As the sketch shows, two holes are drilled through the "open" end of the foot valve, and a ½-in. shaft is inserted. To the middle of the inclosed section of this shaft a short arm, *A*, is welded at right angles; also, a lever is welded to one of the projecting ends of the shaft. When the lever is turned, it rotates the shaft and lifts the short arm, which, in turn, raises the valve disk. The valve is lifted while the pump is working and quickly drains out the water after the pump is stopped. For greatest convenience in working this drain mechanism, a rope should be fastened to an eye at the end of the lever.

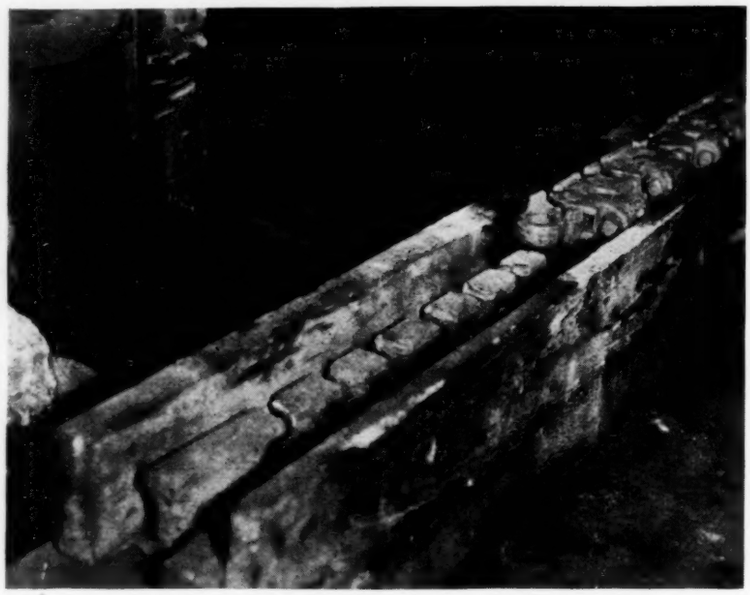


Avoids Necessity of Disconnecting Suction Hose in Draining Pump

Rail Anvil Simplifies Removal Of Cutter Chain Rivets

As mine mechanics will testify, the removal of worn rivets from a cutter chain is aggravating if facilities are not provided for supporting and holding the chain during the completion of the job—this because the chain is unwieldy. This trouble has been entirely eliminated at the Slagle (W. Va.) mines of the Logan County Coal Corporation by a slotted anvil developed by Reuben Lee. With this anvil, rivets have been driven out of a 40-block cutter chain in 35 minutes.

The anvil is adapted from a 30-lb. rail of 10-ft. length. It is best to use new rail for the purpose, as an old rail is likely to be crystallized and break at the flange in places where slots are cut. The base of the anvil (see the illustration) is an 8x8 piece, 10 ft. long. To it the rail is spiked. The slots are cut out, through the ball and web of the rail, to a width ½ in. greater than the head of the rivet, and the centers of the slots, of course, correspond with the centers of



With This Anvil Forty Rivets Can Be Removed in 35 Minutes

the rivets in the chain straps or connectors. These slots are cut through the web to a depth slightly greater than the rivet length.

On the left of the rail is a piece of 2x6 timber which is spiked to the base timber and serves to hold the cutter chain in place. On the right of the rail is a 2x2 which supports the cutter chain—the extreme bottom cutter blocks resting on it. A piece of 1½x6 directly outside the wood rest block completes the channel which holds the chain in line.

Solid Collector Contacts on Hinged Trolley Harp

Frequent trouble from burnouts of "free-wheeling" trolley wheels and harps for mine locomotive service at the Nellis (W. Va.) mine of the American Rolling Mill Co. led T. W. Blake, of that company, to develop an entirely new, hinged, side contact type. One of these last has been in service on a 20-ton main-line locomotive since Oct. 13, whereas the "free-wheeling" type, according to Mr. Blake, would last only five or six days in the same service.

Fig. 1—Harp and Wheel Assembled

Aside from the hinge and other characteristics which facilitate quick adjustment, the main feature of the design is a wheel with a wide side area which makes contact with an equally wide area on the harp. It is this feature which gives long life to both harp and wheel. And as both sides of the wheel are alike, after a period of service the wheel can be turned side for side, thus offering a fresh surface on the wheel at the collecting side of the harp. All parts are of brass except the spindle locking-screw, bushing and spring.

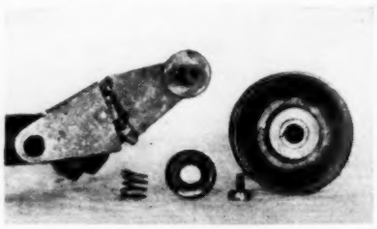


Fig. 2—Harp and Wheel Disassembled to Show Parts

Referring to Fig. 2, the order of assembly is as follows: Place the wheel on the harp spindle; add washer, flat side first; close hinged arm over wheel and spindle; place tension spring and turn in holding nut until it is flush with side of harp.

As the spring provides sufficient tension to hold the collector collars close together, the wheel does not turn freely. In consequence, there is said to be little burning. Patents have been applied for in the name of the coal company.

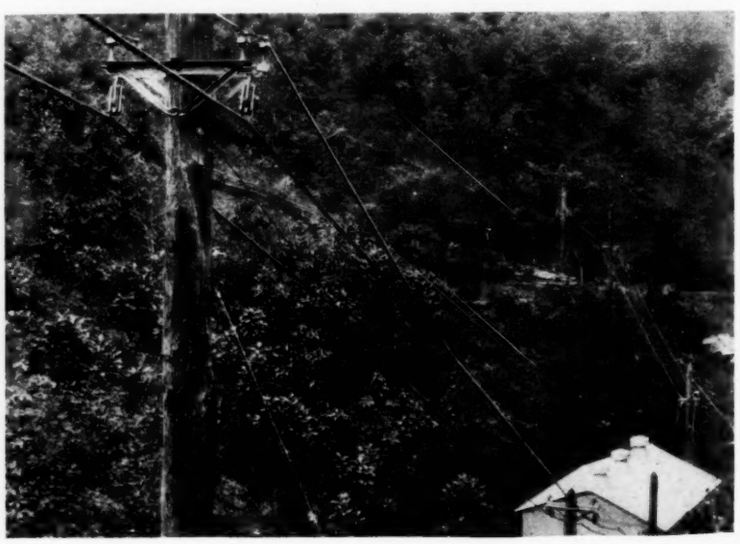
Heavy Feeder Cable Supported Between Pole Spans

Heavy pole equipment is required for supporting 1,000,000-circ.mil copper feeder cable, especially if the sag is to be held within limits insuring neat appearance and if the heaviest possible sleet loads are to be carried without failure.

The illustration shows the method employed at a new substation of the Red Jacket Consolidated Coal & Coke Co., Red Jacket, W. Va. This substation is about half way between a borehole that feeds one mine and a drift opening to a mine in a higher seam. Two 1,000,000-circ.mil 275-volt feeder cables are carried each direction. The pole spacing is 75 ft.

Double crossarms are used. On the top at each end are two pin-type insulators to hold the messenger, and also a clevis type suspension insulator hung from a tiebolt to carry the copper cable. At three points in the span the copper cable is tied directly to the steel messenger. This construction presents a neat appearance and leaves no doubt as to strength.

Sleet Storms Should Not Affect This Feeder Line



WORD from the FIELD

Railroad Fuel Purchases Probed

Testimony on the cost of producing coal was offered in response to a request by the Interstate Commerce Commission at a hearing on practices in the purchase of railroad fuel coal held in Chicago last month. L. E. Woods, president of the Crystal Block Coal & Coke Co., and the Operators' Association of the Williamson Field, presented cost figures for operations in his district. A. O. Wilson, statistician, Kanawha Coal Operators' Association, spoke in behalf of the Kanawha producers, and D. F. Hurd, secretary, Eastern Ohio Coal Operators' Association, appeared for operators in that district. Indiana and Illinois were represented by C. G. Hall, general manager, Walter Bledsoe & Co., and W. Y. Wildman, traffic manager, Illinois Coal Bureau.

In general, the testimony of the witnesses showed that the railroads have not been paying more than a fair price for coal in their districts, and that in some instances the carriers have not paid the average cost of production in the field.

Illinois Coal Rate Decision

The lower intrastate coal freight rates prescribed in 1928 by the Illinois Commerce Commission between certain points within the state were found by the Interstate Commerce Commission to result in unjust discrimination against interstate traffic in a decision on March 8. Reasonable rates, or rate bases, involving in the majority of cases an increase of 5c. per ton, were prescribed for the future. In connection with the examination of related matters, the commission found that interstate rates from points in Illinois to Chicago were not unreasonable, but that interstate rates from certain points in the state to Quincy were unreasonable; reasonable rates were prescribed.

Rates on bituminous coal from Indiana and western Kentucky to Moline, East Moline, Rock Island, and Silvis, Ill., were found not unreasonable in the past but unreasonable and unduly prejudicial in the future in so far as they exceeded rates prescribed in the decision. A similar decision was made on rates from points in Illinois, Indiana, and western Kentucky to Davenport, Bettendorf, Iowana, Riverside, Davis Gardens, and Buffalo, Iowa. Rates on coal from Alpha, Ill., to Iowa destinations within 100 miles of Davenport were found to be unreasonable and unduly prejudicial; reasonable and non-prejudicial rates were prescribed, and reparation awarded.

In a supplementary decision on March 14, the Commission found that rates from Fulton, Peoria, and Tazewell counties and certain mines in the Springfield group to the Peoria-Pekin (Ill.) switching district resulted in undue discrimination against interstate traffic, and prescribed reasonable rates for the future.

See Decline in Coal Shipments

Shipments of coal and coke are expected to decline 9.7 per cent in the quarter beginning April 1, according to estimates submitted by shippers of the country to the Shippers' Regional Advisory Boards. Actual loadings of coal and coke in the second quarter of 1931 totaled 1,649,870 cars, and the shippers estimate that the loadings in the second quarter of this year will be 1,490,302 cars.

Coal Production Rises

Bituminous coal production, under the stimulus of cold weather, rose to 32,320,000 net tons in March, according to preliminary estimates by the U. S. Bureau of Mines. The output in February was 28,013,000 tons, while the total production in March, 1931, was 33,870,000 tons. Anthracite production also rose in March to 4,786,000 net tons, against 4,019,000 tons in February, and 4,745,000 in March, 1931.

Total production of bituminous coal for the first quarter of 1932 was 88,225,000 net tons, as compared with 103,820,000 tons in the corresponding period in 1931. Anthracite production for the first three months of this year was 12,702,000 net tons, against 16,293,000 tons in the same months in 1931.

N. C. A. Will Defray Expenses Of Appalachian Coals Suit

Directors of the National Coal Association voted unanimously at a meeting in Washington, D. C., March 10, that the association should bear the cost of the litigation in the Appalachian Coals test suit. Developments last month indicated that the suit will get under way in the near future, with a final decision some time next autumn. Great interest is being manifested in the action by representatives of the oil, copper, and lumber industries, and the Mineral Law Section of the American Bar Association devoted a session to discussion of the sales agency plan at a meeting in Washington, March 22.

Seeking an alternative to the direct amendment of the anti-trust laws, several representatives of the natural resource industries have proposed legislation that would permit them to negotiate agreements for curbing production with the sanction of the Federal Trade Commission. Their proposal, in the form of an amendment to the Nye bill to give specific legal status to the commission's conference procedure for the elimination of unfair trade practices, was approved by Secretary of the Interior Wilbur at a hearing on March 31 before a subcommittee of the Senate Judiciary Committee.

Agreements providing rules of business conduct that would be authorized by the Nye bill, would, under the amendment proposed by Senator Steiwer, Oregon, be extended to include "in the case of natural resource industries, reasonable agreements to adjust production to consumption, to avoid waste, conserve natural resources, and maintain security and continuity of employment." W. M. Ritter, Red Jacket Consolidated Coal & Coke Co.; E. J. McVann, traffic manager, Property Owners' Committee, representing Southern coal interests, and J. F. Callbreath, secretary, American Mining Congress, appeared in favor of the amendment.

Mead to Install Washery

Mead Smokeless Coal Co., Beckley, W. Va., closed a contract with the McNally-Pittsburg Manufacturing Corporation in March for the installation of a Norton automatic coal washing unit at the No. 4 mine, Mead, W. Va. The washer will clean egg coal, and the capacity will be 65 tons per hour.

Hearings on Davis-Kelly Bill Started; Operators Divided on Measure

LEGALIZATION of agreements for restriction of production and fixing of prices that will give a fair return to operating companies and a living wage to miners, in so far as these agreements are warranted by the public interest, is the major aim of the Davis-Kelly bill, declared Representative Kelly, Pennsylvania, at the initial hearing before the subcommittee of the Senate Committee on Mines and Mining, held in Washington, D. C., March 14. The sales agency plan was developed to accomplish the same things, but is of doubtful legality. In return for the relief from restriction of the anti-trust laws, Mr. Kelly contended that the coal industry should not object to the provisions of the bill designed to protect labor.

Congress, he declared, has undivided power to license corporations in interstate commerce, and the success of the joint selling provisions would depend upon requiring all corporations to take out such licenses. No specific details on the methods of regulation were included in the bill, as it was thought that the interests of the industry and the public would be better served if the proposed Bituminous Coal Commission were allowed to make its own regulations to fit conditions. Mr. Kelly stated that he had no objections to the appointment of one commission member to represent the operators and another to sit for the miners.

Further affirmative opinion on the right of Congress to license corporations engaged in interstate commerce, and to make such regulations as it sees fit as a condition of such licensing, was submitted at the second hearing, March 17, by Edmund D. Campbell, Washington attorney, and Henry Warrum, counsel for the United Mine Workers. Mr. Campbell based his remarks on a report which he prepared for the U. S. Coal Commission in 1923, but admitted that the proposed legislation might be upset by the Supreme Court on the ground that it was a device to control indirectly what otherwise could not be controlled directly. Mr. Warrum declared that the operators should not be allowed to receive benefits from joint selling agencies while the mine workers were not able to organize and were subject to the restrictions of "yellow-dog" contracts, and that the sales agency plan was adopted by the operators to delay legislation until the legality of cooperative measures could be tested out in the courts.

William Green informed the subcommittee that the executive council of the American Federation of Labor had approved the bill, and added his personal recommendation and approval. As the hearing drew to a close, Senator Hayden, of the committee, declared that it was little use to go ahead in the absence of reports approving the bill from any government department.

Marshall J. H. Jones, Associated Coal Corporation, Pittsburgh, Pa., was the first witness when hearings were resumed on March 22. Mr. Jones went on the stand after Senator Hayden had reiterated his remarks that the committee should not proceed further until some departmental opinion was obtained, and declared that he favored the Davis-Kelly bill with the proviso that the labor unions should be compelled to incorporate so that operators would be signing agreements with responsible bodies.

C. F. Hosford, Jr., president, Butler Consolidated Coal Co., Butler, Pa., also favored some form of regulation which would protect the operator, the miner, and the public, and offered for consideration a bill which he had prepared. This bill he explained, would conserve the coal resources of the country; prevent waste; promote safety and efficiency; regulate interstate and foreign commerce in coal; regulate and limit importation of coal and other fuels; permit and regulate consolidations, mergers, and cooperative marketing; require the licensing of individuals, partnerships, associations, and corporations producing and shipping coal in interstate commerce; license and regulate associations and organizations of miners; regulate rates charged for the transportation of coal in interstate commerce; and create a Bituminous Coal Commission.

Howard W. Showalter, president, Continental Coal Co., Fairmont, W. Va., declared his belief that "there can be no stabilization of the coal industry without stabilizing wages and making them uniform in the respective districts." While the operators are trying to help themselves, he felt that they cannot cope with the evils of actual and potential production "without some form of government control." John L. Hatfield, president, Rosedale Coal Co., Morgantown, W. Va., indorsed the bill as "a means to help stabilize the coal industry at the present time."

Ex-Governor Flem D. Sampson, Kentucky, declared that the objects and purposes of the sales agency plan appear to coincide with the letter and spirit of the bill, and that the bill seems to give the coal industry everything it asks for except standardization of production costs through standardization of district wage scales. Van A. Bittner, Fairmont, W. Va., chief representative of the United Mine Workers, presented numerous petitions from citizens in the Fairmont region asking for legislation. Frank Woods, O'Gara Coal Co., and Howard Swallow, United Electric Coal Cos., wired the committee that they could not attend the hearings because of the wage negotiations in Illinois, but that they favored the bill.

Hearings will be continued on April 18, and it is expected that representatives of the operators will be granted an opportunity to oppose the bill then or at other future sessions. The National Coal Association, local coal operators' associations, and individual companies actively prosecuted efforts to organize opposition in March and the early part of April, and several groups approved resolutions condemning the bill. In addition to the spokesmen for the operators, it is expected that the U. S. Chamber of Commerce, National Association of Manufacturers, Association of Railway Executives, and the American Bankers' Association will appear in opposition.

Railroads Make Fuel Record

Class 1 railroads burned 119 lb. of coal in 1931 in hauling 1,000 tons of freight, including locomotive and tender, one mile. This is the lowest average attained by the carriers since the compilation of reports of fuel consumption began in 1930, and is 2 lb. under the 1930 average. Passenger trains also established a new low record in 1931, burning 14.5 lb. of coal per passenger-train car-mile, against 14.7 lb. in 1930.

Total consumption of coal by Class 1 railroads in road train and yard switching service was 81,231,867 tons in 1931, a decrease of 17.0 per cent from the 1930 figure of 97,858,235 tons. Consumption of fuel oil in 1931 was 1,992,076,228 gal., a decrease of 14.1 per cent from the 1930 total of 2,320,697,209 gal.

Anti-Injunction Bill Signed

President Hoover signed the Norris-LaGuardia anti-injunction bill last month, after being advised by Attorney General Mitchell that he need not concern himself with the question of the constitutionality of the measure. The act outlaws the "yellow-dog" contract in the federal courts and limits the powers of these courts in labor disputes, particularly where the issuance of injunctions restraining concerted action by labor is concerned.

Retailers to Discuss Sales And Competition

Pressing problems facing the retail coal dealer will be the major theme of the 15th annual meeting of the National Retail Coal Merchants' Association, to be held at Louisville, Ky., May 19-21. Successful examples of combating trucking from the mines and "snowbird" competition will be detailed by various speakers, and the convention will take up the problems of oil and gas competition. Large delegations from all sectinos of the country are expected to attend, according to preliminary announcements of the Louisville committee.

Varied Program Prepared for Coal Men At Cincinnati Convention

ADMINISTRATION problems in coal mining, economies in coal production, mining methods, safety and accident prevention, power distribution, mechanical loading, coal preparation, and organization problems are among the topics scheduled for discussion at the ninth annual convention and exposition of coal mining equipment, to be held at the Music Hall, Cincinnati, Ohio, May 2-7, under the auspices of the Manufacturers' Division of the American Mining Congress. George C. McFadden, assistant vice-president, Peabody Coal Co., chairman, is head of the committee in charge of the convention program. Other officials in active charge of the convention arrangements are: L. W. Shugg, General Electric Co., in charge of exhibits; J. F. Callbreath, secretary of the American Mining Congress; Charles C. Whaley, Myers-Whaley Co., Knoxville, Tenn., chairman of the Manufacturers' Division; and Mrs. E. R. Coombes, secretary of the program committee and the Manufacturers' Division.

Papers slated for presentation at the convention are as follows:

Monday—"Engineering as a Factor in Successful Operation," R. L. Ireland, Jr., vice-president, Hanna Coal Co., Cleveland, Ohio; "Cash—A Coal Mining Implement," Newell G. Alford, consulting engineer, Pittsburgh, Pa.; "Treated Timbers," Paul Weir, vice-president, Bell & Zoller Coal & Mining Co., Zeigler, Ill., with discussion by Fred A. Graf, Union Pacific Coal Co., Rock Springs, Wyo.; "Economies Through Proper Power Distribution," Carl Lee, electrical engineer, Peabody Coal Co., Chicago, with discussion by W. E. Wolfe, Clinchfield Coal Corporation, Dante, Va.; "Economies and Savings Through the Use of Mechanical Loaders," H. B. Husband, general manager of fuel mine operations, Chesapeake & Ohio Ry., Dorothy, W. Va.; "Economies of Arc Welding," A. E. Steiger, general superintendent, Pyramid Coal Corporation, Pinckneyville, Ill.; "Economies Through New Types and New Uses of Materials," R. E. Hobart, mechanical superintendent, Lehigh Navigation Coal Co., Lansford, Pa.

Tuesday—"Room & Pillar Mining With Conveyors," R. H. Morris, general manager, Gauley Mountain Coal Co., Ansted, W. Va.; "Mining Longwall Panels With Top Cutters and Conveyors," C. A. Griffith, vice-president, Pruden Coal & Coke Co., Pruden, Tenn.; "Making Pillar Falls Safely," D. A. Reed, Consolidation Coal Co., Jenkins, Ky.; "Accident Prevention—A Vital Problem," Lee Long, vice-president, Clinchfield Coal Corporation, Dante, Va.

Wednesday—"Automatic Pump Control Underground," D. E. Ingersoll, Pittston Co., Scranton, Pa.; discussion of electric maintenance problems, J. A. Long, Woodward Iron Co., Woodward, Ala.; "Care and Recovery of Supplies Underground," H. A. Treadwell, general superintendent, Chicago, Wilmington & Franklin Coal Co., Benton, Ill.; "Problems in Coal-Mine Power Distribution," Frank E. Gleason, general master mechanic, United States Fuel Co., Salt Lake City, Utah.

"Low Costs and Loading Machines," W. J. Jenkins, president, Consolidated Coal Co. of St. Louis, St. Louis, Mo., with discussion by Edward Bottomley, Sheridan-Wyoming Coal Co., Kleenburn, Wyo.; "Tonnage, Loading and Development Work With Track-Mounted Machines," John H. Richards, Hanna Coal Co., St. Clairsville, Ohio, with discussion by John R. Foster, Chicago, Wilmington & Franklin Coal Co., Chicago; "Cutting and Handling Cuttings in One Operation," L. W. Householder, Rochester & Pittsburgh Coal Co., Indiana, Pa., with discussion by L. N. Thomas, Carbon Fuel Co., Carbon, W. Va.; "Premium Payment for Mechanical Loading," I. N. Bayliss, assistant general manager, Union Pacific Coal Co., Rock Springs, Wyo.; "Strip Mining in the Southwest," L. Russell Kelce, Sinclair Coal Co., Kansas City, Mo.

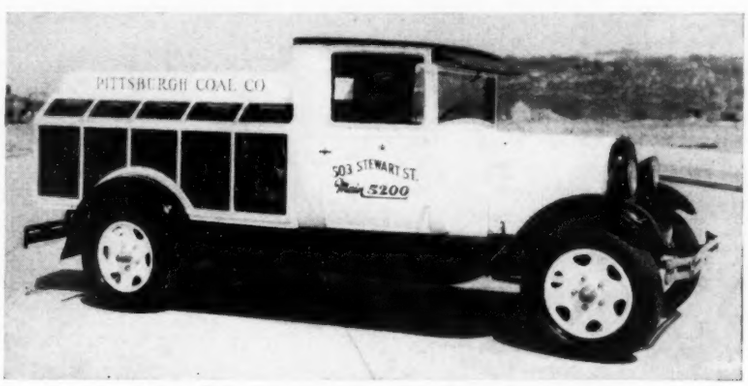
Thursday — "Economies to Be Effected by Coal Cleaning," Byron M. Bird, chief concentration engineer, Battelle Memorial Institute, Columbus, Ohio, with discussion by C. W. Connor, American Rolling Mill Co., Nellis, W. Va.; K. A. Spencer, Pittsburg & Midway Coal Co., Pittsburg, Kan.; D. A. Thomas, Montevallo Coal Mining Co., Birmingham, Ala.; Joseph Pursglove, Jr., Pittsburgh Terminal Coal Corporation, Castle Shannon, Pa.; "Meeting the Safety Problems of the Rocky Mountain Region," Wm. Moorhead, general superintendent, Utah Fuel Co., Castle Gate, Utah; "Accident Prevention With Protective Hats, Hard-Toed Shoes and Goggles," D. W. Jones, superintendent, Valier Coal Co., Chicago, with discussion by C. W. Gibbs, general manager, Harwick Coal & Coke Co., Pittsburgh, Pa., and A. J. Ruffini, Wheeling Township Coal Mining Co., Adena, Ohio; "Signal System for Mine Service," L. C. Skeen, Fordson Coal Co., Stone, Ky.; "Organization, Morale and Personal Equation," J. S. McKeever, general superintendent, Kanawha & Hocking Coal & Coke Co., Longacre, W. Va., with discussion by J. D. Rogers, Stonega Coke & Coal Co., Big Stone Gap, Va., and B. C. Osler, Pardee Bros. & Co., Hazleton, Pa.

Friday—"The Real Coal Problem," Flem D. Sampson, former Governor of Kentucky with discussion by leaders in the industry.

The following operators have been invited to serve as chairmen of the twice-daily sessions: P. C. Thomas, vice-president, Koppers Coal Co., Pittsburgh, Pa.; J. D. Zook, commissioner, Illinois Coal Operators' Association, Chicago; Thomas Moses, president, H. C. Frick Coke Co., Scottdale, Pa.; Dr. L. E. Young, vice-president, Pittsburgh Coal Co., Pittsburgh, Pa.; and E. W. Judy, vice-president, Duquesne Light Co., Pittsburgh. Sixty-two manufacturers have already arranged to exhibit equipment.

To Study Friability of Coal

Methods of determining friability of coal will be studied by a subcommittee of the Coal and Coke Committee of the American Society for Testing Materials. This subcommittee was organized at a meeting in Cleveland, Ohio, March 7. R. E. Gilmore, Department of Mines, Canada, heads the group, which will be made up of investigators from both Canada and the United States.



The Customer Sees What He Buys

G. O. Vincent, Pittsburgh Coal Co., Seattle, Wash., relies on the above display truck as a means of increasing his sales in the face of competition from substitute fuels and his brother coal dealers. The body of the truck is divided into ten compartments, five on each side. Each of the compartments holds 80 lb. of coal and is properly marked with the grade and price. Upon call, the truck is sent to the customer's home to assist him in making his selection, and in slack times tours the streets to remind the consumer to lay in supplies before cold weather comes, and to advertise the Pittsburgh Coal Co's service.

Holmes Association Makes Safety Awards

Announcement of awards for feats of individual heroism in mines or remarkable safety records featured the last annual meeting of the Joseph A. Holmes Safety Association. Silver medals and diplomas for incurring serious personal risk in successful efforts to save the lives of fellow employees were awarded to Jesse Engle and Harry Couch, Ajax Coal Co., Dulan, Ky.; Glen Stevenson, Columbia Steel Co., Columbia, Utah; and John Regets, Cambridge Collieries Co., Walhondling Mine, Buffalo, Ohio.

In addition to personal awards, the following coal companies and mines were given certificates of honor for operation over long periods of time without fatalities, or with a minimum of compensable accidents: Pennsylvania Coal & Coke Corporation, Colliery 17, Barnesboro, Pa., and Mine 8, Ehrenfeld, Pa.; Liberty Fuel Co., Liberty mine, Latuda, Utah; Bethlehem Mines Corporation, Mine 71, Johnstown, Pa.; Bird Coal Co., Tire Hill, Pa.; Rochester & Pittsburgh Coal Co., Soldier No. 1, Soldier, Pa.; Youngstown Mines Corporation, Dehue, W. Va.; Union Pacific Coal Co., Mine 4, Rock Springs, Wyo.; and "C" mine, Superior, Wyo.; Taylor & McCoy Coal & Coke Co., Gallitzin, Pa.; Ellsworth Collieries Co., Mine 58, Marianna, Pa.; Sheridan-Wyoming Coal Co., Hotchkiss and No. 54 mines, Kleenburn, Wyo.; Calumet Fuel Co., Somerset, Pa.; Penelec Coal Corporation, Seward, Pa.; Ebensburg Coal Co., Ebensburg No. 1, Colver, Pa.; Empire Coal Mining Co., Barnesboro, Pa.; Rockhill Coal & Iron Co., Rockhill 8, Robertsdale, Pa.; South Union Coal Co., Uniontown, Pa.; Buckeye Coal Co., Brier Hill, Pa.; Pacific Coast Coal Co., Carbonado, Wash.; Windsor Power House Coal Co., Windsor Heights, W. Va.; Phelps Dodge Corporation, Mine 1, Dawson, N. M.; West Kentucky Coal Co., Sturgis, Ky.; DeBardeleben Coal Corporation, Birmingham, Ala.; United States Fuel Co., Salt Lake City, Utah; and the Electro-Metallurgical Co., Alloy, W. Va.

The second annual State-Wide Accident Prevention Campaign sponsored by the Virginia Manufacturers' Association got under way on April 1, and will extend over the months of April, May, and June. The coal-mining industry in the state has been placed in a separate class, due to its difference from other industries in Virginia.

The Imboden colliery of the Stonega Coke & Coal Co., Imboden, Va., has operated without a lost-time accident from March 20, 1931, to March 21, 1932. An average of 251 men have been employed and the man-hours of exposure during the 366-day period totaled 317,292.

Eighteen Kentucky companies mined more than 225,000 tons in 1931 without a fatal accident, according to reports released by the Kentucky Department of Mines. The West Kentucky Coal Co. heads the list with 1,863,663 tons; the Columbus Mining Co. is second with 502,952 tons; while the King-Harlan Co. is third with 368,908 tons. The other fifteen companies, in relative order, are: Beaver Dam Coal Co., Blackwood Coal & Coke Co., South-East Coal Co., Benedict Coal Corporation, Greenville Coal Co., Diamond Coal Co., Gibraltar Coal Mining Co., Utilities Coal Co., Pike-Floyd Coal Co., North-East Coal Co., Black Diamond Coal Co., Hart Coal Corporation, Carbon Glow Mines, Inc., R. C. Tway Coal Co., and the Kenmont Coal Co.

A record for operating since April 16, 1923, without a single fatality was hung up by the No. 4 mine of the Union Pacific Coal Co., Rock Springs, Wyo., at the end of 1931. During this period of almost nine years, 2,476,122 tons of coal was produced. "C" mine, Superior, closed 1931 with a record of nearly 4½ years without a fatality, during which time 1,019,753 tons of coal was mined.

"Kleen-Blox" Plants Installed

Two plants for the production of fuel briquets from ¾x0-in. slack coal or coke have been installed by the Glen Smith Coal Co. at Council Bluffs, Iowa, and the Tahona Coal Co., at Tahona, Okla. The Council Bluffs plant uses petroleum coke, while the Tahona plant operates on semi-anthracite slack, selling the production readily in Kansas City and Omaha for domestic use. The "Kleen-Blox" process, according to reports, requires but half the usual quantity of binder to make briquets that will withstand shipping and handling with a minimum percentage of degradation. Operation is said to be simple, and common labor can be employed. Roberts & Schaefer Co., Chicago, has been appointed exclusive agent to design and build plants using the process.

"Clean" Coal Code

Development of a standard code of specifications for "clean" coal was proposed to the board of directors of the National Coal Association last month by Howard N. Eavenson, consulting engineer, Eavenson, Alford & Hicks, Pittsburgh, Pa. Mr. Eavenson defined the scope of the proposed code as follows: "Specifications outlining allowable limits of inacceptible material in any size of prepared bituminous coal, whether mechanically cleaned or not; the purpose being to define 'clean' coal, and not to standardize screen sizes." The board authorized the appointment of a representative to serve on the committee that will be set up by the American Standards Association to consider the matter, and expressed the viewpoint that the proposed specifications, if adopted, should be limited to coal above 2 in. G. B. Seyms, general sales manager, Westmoreland Coal Co., Philadelphia, Pa., was later chosen to represent the association.

Coal Tariffs Proposed

Several bills were introduced in the House of Representatives last month calling for a tariff on coal and/or coke. A duty of 15c. per 100 lb. on imported anthracite, bituminous coal, coke, or briquets is proposed in bills offered by Representatives Turpin, Coyle, Brumm, Wyant, and Boland, of Pennsylvania. Representative Smith, Pennsylvania, proposed a duty of $3 a ton on coal, coke, and briquets, and a bill sponsored by Representative Smith, West Virginia, would impose a tariff of $1 per long ton on bituminous coal imported into the country.

The duty of 15c. per 100 lb. proposed in the majority of the bills presented last month received the support of the anthracite industry, through Brice P. Disque, executive director, Anthracite Institute. In a letter to Representative Coyle, chairman of a congressional group representing the anthracite areas, Mr. Disque pointed out that while the industry is making every effort to adjust the domestic and internal situation, the volume of importations has steadily increased, with the result that anthracite employees lost $15,000,000 in 1931.

Explosives Approved

Four additions to the active list of permissible explosives were made by the U. S. Bureau of Mines in January and February, as follows:

Austin Powder Co., Red Diamond No. 5, L. F.; volume of poisonous gases, less than 53 liters; characteristic ingredient, ammonium nitrate with explosive sensitizer; weight of 1¼x8-in. cartridge, 161 grams; smallest permissible diameter, 1 in.; unit deflective charge, 229 grams; rate of detonation of 1¼-in. diameter cartridge, 8,040 ft. per second.

Illinois Powder Mfg. Co., Black Diamond Nu-Gel No. 1; volume of poisonous gases, less than 53 liters, characteristic ingredient, nitroglycerin gelatinized with nitrocotton; weight of 1¼x8-in. cartridge, 244 grams; smallest permissible diameter, ¾-in.; unit deflective charge, 274 grams; rate of detonation of 1¼-in. diameter cartridge, 13,580 ft. per second.

Liberty Powder Co., Liberty No. 4; volume of poisonous gases, between 53 and 106 liters, inclusive; characteristic ingredient, ammonium nitrate with explosive sensitizer; weight of 1¼x8-in. cartridge, 171 grams; smallest permissible diameter, ¾-in.; unit deflective charge, 240 grams, rate of detonation of 1¼-in. diameter cartridge, 7,250 ft. per second.

Liberty Powder Co., Liberty No. 5; volume of poisonous gases, less than 53 liters; characteristic ingredient, ammonium nitrate with explosive sensitizer; weight of 1¼x8-in. cartridge, 186 grams; smallest permissible diameter, ¾-in.; unit deflective charge 227 grams; rate of detonation of 1¼-in. diameter cartridge, 10,000 ft. per second.

Basic data on one explosive was changed to the following:

Austin Powder Co., Austin Red-D-Gel; volume of poisonous gases, less than 53 liters; characteristic ingredient, nitroglycerin gelatinized with nitrocotton; weight of 1¼x8-in. cartridge, 244 grams; smallest permissible diameter, 1 in.; unit deflective charge, 263 grams; rate of detonation of 1¼-in. diameter cartridge, 14,760 ft. per second.

Operations Suspended in Illinois and Indiana; Anthracite Strike Ends

FAILURE to complete negotiations for a wage contract resulted in a suspension of operations in Illinois on April 1, affecting approximately 65,000 men and practically all the mines, strip and shaft, in the state. Representatives of the miners and the operators found themselves diametrically opposed when the joint wage conference got under way in Chicago on March 8. The miners, in accordance with the decision at the last state convention, stood out for a shorter working day and week, and for an increase of 33⅓ to 50 per cent in wages, which would make the new basic day scale $7, against the old scale of $6.10. Operators cited the wage advantage of competitive fields, and requested a reduction, offering, on March 22, the union scale now in effect in northern West Virginia. The rates under the northern West Virginia scale and the old Illinois scale are compared in the following table:

Loading:	Northern W. Va. Per Ton	Illinois, Per Ton
Machine mining	$0.225	$0.80@$1.00
Pick mining	0.285	0.87@ 1.07
	Per Day	Per Day
Picking labor	$1.80	$3.50@$5.61
Tipplemen and other outside common labor	2.10	5.61
Motormen	2.70	7.00
Track men and timbermen	2.70	6.10
Track helpers, timber helpers, slatemen, pipemen, pumpers, bratticemen, couplers greasers, other inside common labor	2.40	5.95
Tripriders	.....	6.10
Loading and cutting machine men	.....	10.07
Loaders on conveyors	.....	8.04

Union representatives immediately rejected the March 22 offer, and the operators on March 24 proposed a scale approximately 10 per cent above the average wage said to be paid in competing fields. Although exact figures were not given, it was understood that under this proposal the basic day rate would be $3.90 to $4 a day. Reports were current at the end of the month that both sides were considering a compromise. Meetings of the subcommittee which has been striving to arrive at a suitable basis of agreement were adjourned on April 2 at the request of the miners, and will be resumed April 13.

Six deep-shaft mines and one strip mine were operating in Illinois in early April, and in addition twenty or more cooperative mines (shaft) were running in the Belleville district.

Indiana deep-shaft mines, which operated under the same scale as Illinois operations, also closed down on April 1, and operators prepared for a finish fight with the union in Distict 11. Approximately 20,000 miners suspended work when the negotiations broke down after the miners' representatives refused to consider the contention of the operators that competition from other fields made a lower scale necessary in Indiana. An operators' committee was formed to develop a proposition for presentation to the union if it evidenced a willingness to continue negotiations, or to individual miners if the union refused to consider it. The proposition, understood to provide for a reduction of approximately 33⅓ per cent from the old wage scale, or a base day rate of $4.50 for inside labor, $3.50 for outside labor, and 60c. per ton for loading, was published on April 5. On the same day, rioting at the Somerville and Starbourn mines, near Sullivan, caused Governor Leslie to threaten to call out state troops if disorders continued.

Strip operations, which account for 35 per cent of the Indiana production, continued to operate, as representatives of the operators and miners agreed on March 26 to extend the old contract providing for a basic wage of $6.10 per day, with the proviso that the scale would later be revised in conformity with the new deep-shaft scale, if negotiated. Cooperative mines, which are an important factor in the Indiana production, also continued to operate after April 1.

Climaxing a month of conflict between operators and miners, Lee Hall, president, District 6, United Mine Workers, called a strike of union miners in Ohio and the northern Panhandle of West Virginia on April 1. The strike call followed the refusal of operators to meet with union officials to consider reestablishment of collective bargaining in the district. Attempts to reopen two mines (Sunday Creek Coal Co. No. 6, Millfield, and the Lick Run mine of the Hocking and Athens Coal Co., Nelsonville) in southern Ohio, where a strike has been in effect since a new and lower uniform scale of wages was posted on Feb. 1, resulted in the dynamiting of a railroad bridge leading to the No. 6 operation and attacks on National Guard officers and mine officials on March 19 and succeeding days. Governor White threatened to send troops into the area if the disorders continued.

Miners employed by the Hanna Coal Co. and the Ohio & Pennsylvania Coal Co. struck in eastern Ohio on March 23, following announcement of wage cuts. The Ohio & Pennsylvania company slashed wages 15 per cent, and the Hanna Coal Co. reduced the basic day rate from $4.30 to $3.20. Employees at three of the Hanna operations voted to accept the cuts, but the Piney Fork miners refused, with the result that the company made preparations at the end of the month to close down the two operations. Muskingum County authorities were forced to use tear gas at Zanesville, April 5, to disperse 1,000 rioting miners from adjacent counties.

The outlaw strike called by insurgent anthracite miners on March 14 for the purpose of securing equalization of working time at all collieries came to an end on April 1, when the last remaining strikers voted to return to work. The strike, led by Thomas Maloney, a breaker laborer at the Stanton Colliery of the Glen Alden Coal Co., was mainly directed at operations of the Glen Alden company, Lehigh Valley Coal Co., Pittston Co., and the Philadelphia & Reading Coal & Iron Co. At its height, 12,000 men were involved in the areas around Scranton and Wilkes-Barre, in District 1, while 2,000 men walked out at Pottsville and Shenandoah, in District 9. Clashes with peace officers, dynamitings, and attacks on workers featured the stoppage. As an outgrowth of the walkout, Maloney and four other insurgent leaders were discharged by the Glen Alden company on April 1 for interfering with operations of the collieries.

The United Mine Workers, after having withdrawn from southeastern Kentucky when the National Miners' Union came in a year ago, embarked on a new organization campaign on April 1. A mass meeting was held at Pineville on that date as the first step in recruiting support to the United Mine Workers, with William Turnblazer, president, District 19, delivering the chief address. Turnblazer declared that if the operators would sign with the United Mine Workers the union would take care of the Communists.

Refusal to permit a delegation of students to enter Harlan and Bell Counties last month resulted in renewed agitation for a Congressional investigation of conditions in southeastern Kentucky, though no definite action had been taken early in April. Trouble broke out in western Kentucky on March 31 with the dynamiting of the power lines of the Kentucky Utilities Co. near Providence. The same night a negro miner was shot from ambush at Madisonville. The substation of the Williams Coal Co., Mannington, was dynamited on April 4, causing a loss of $15,000 and throwing 200 men out of work.

Wage reductions averaging about 10 per cent were posted at the end of March in central Pennsylvania by the Rochester & Pittsburgh Coal Co., Buffalo & Susquehanna Coal & Coke Co., Clearfield Bituminous Coal Corporation, Allegheny River Mining Co., and the Northwestern Mining & Exchange Co. Loading rates were reduced 10c. per ton, and the inside day wage was cut to a maximum of $4.76. Low wage scales in competitive fields were given as the reason for the reduction, which affects 10,000 men.

About 1,400 miners employed by the International Coal & Coke Co. and the McGillivray Coal Co., Ltd., were on strike in the Crow's Nest Pass field of Alberta at the end of the month. Reasons given for the stoppage were dismissals for insubordination and dissatisfaction with the distribution of work. The Mine Workers' Union of Canada (Communist) sponsored a convention of miners at Lethbridge, March 24, at which time it was decided to negotiate with the operators for renewal of the old wage scale, which expired

March 31, provided no wage reductions were proposed. Otherwise, a vote for a general strike will be taken April 11.

Members of the United Mine Workers in Nova Scotia refused to accept a cut in wages proposed by the Duncan Commision, which investigated conditions in the province as a result of the action of the Dominion Steel & Coal Corporation, Ltd., in proposing a wage reduction some time ago. The new scale allowed by the commission went into effect March 15. Union officials instructed the miners to remain at work pending further action.

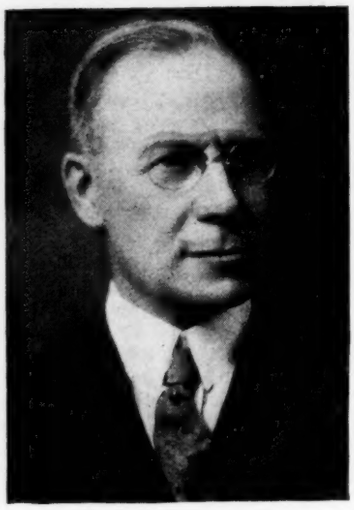
H. S. Gay Dies

H. S. Gay, Sr., vice-president and general manager of the Gay Coal & Coke Co., Mt. Gay, W. Va., died at his home in Baltimore, Md., April 7, after a long illness. Mr. Gay was graduated from Lafayette College and began his mining career with the Philadelphia & Reading Coal & Iron Co. He later held engineering and managerial positions with the Susquehanna Collieries Co., J. Langdon & Co., owners of the Nelson Colliery, and the New Jersey Concentrated Iron Ore Co. For a number of years prior to 1903 he was a consulting mining engineer. A trip to Logan County in that year to examine coal lands resulted in his taking a lease on the Gay mine, which he actively managed until 1912.

Coal and Mechanical Engineers Discuss Anthracite Mining

Annual production of anthracite in the United States exceeds in value the entire production of gold throughout the world, said Dr. Scott Turner, Director, U. S. Bureau of Mines, at a meeting of the Anthracite Section of the American Institute of Mining and Metallurgical Engineers held at Wilkes-Barre, Pa., March 12. Also, value of the annual anthracite production is eight times the value of all the gold produced in the United States, and eighteen times the value of all the silver.

Emerson H. Todd read a paper by A. S. Rairden, chief engineer, American Cable Co., New York City, on "How Wire Rope Construction Affects Selection," in which he described the spinning of wire rope. G. W. Beehler, mining engineer, Glen Alden Coal Co., Scranton, Pa., described the sinking of the historic Dundee shaft, the beginning of a new era in the anthracite industry. Incorporated in 1832, the Dundee Coal Co. began in 1855 to sink an 8x12-ft. shaft to the Nanticoke, or Mills, bed, a depth of about 792 ft. No provision was made, apparently, for a return air compartment and, after driving west of the shaft 140 ft., east about 50 ft., and south about 50 ft., and connecting the south and east headings by a circular gangway, the shaft was abandoned. It was later enlarged, after first being filled with culm, and the top of the shaft was raised 70 ft. by a chimney-like structure. Mr. Beehler then described the difficulties encountered in sinking the Woodward shaft some years ago.



The Late H. S. Gay

Undercutting machines were held back at first in the anthracite region by the difficulty of getting machines with the requisite stamina for cutting the coal, and also by the fact that the coal they were required to cut was so low that, at the face, there was no track on which they could be flitted, declared Thomas F. Steele, general manager, Penn Anthracite Mining Co., Scranton, Pa., at a meeting of the Lehigh Valley Section of the American Society of Mechanical Engineers held at Wilkes-Barre, Pa., March 24.

Scrapers were first devised for use in scraping the coal to the hatches in Great Lakes vessels, declared Paul Sterling, mechanical engineer, Lehigh Valley Coal Co., Wilkes-Barre, and a scraper of this type was the first to be introduced into the Lehigh Valley mines. In 1909, shaking chutes after a type developed in the Rand gold mines were installed at the William A. colliery, but it was found that they reciprocated without giving much forward motion to the coal, which traveled by gravity.

The Ruhr district is governed by its own conditions, said James H. Pierce, consulting engineer, Stuart, James & Cooke, New York City. Its coal could be readily cut by pickhammers, as it has a marked cleat which facilitated demolition. Undercutting machines made rapid progress in the Ruhr up to 1925, but afterward began to decline, while the number of pickhammers increased until, in 1930, they produced 70 per cent of the tonnage. Output per shift rose from 2.8 tons in 1913 to 5.8 tons in 1931.

In discussing Mr. Pierce's remarks on the advantages of pneumatic filling, Mr. Evans declared that at the Loree mine the Hudson Coal Co. had been experimenting with a low-pressure pneumatic system, employing a star feeder to furnish the material and an air pressure of 8 lb. per square inch to transport breaker refuse 350 ft. through angles as high as 360 deg. Several thousand cubic feet of material was thus deposited.

Mine Inspectors to Canvass Safety Problems

Safety in coal mines will again be the theme of the twenty-third annual convention of the Mine Inspectors' Institute of America, to be held at the Mallow-Sterling Hotel, Wilkes-Barre, Pa., May 9-11. Papers scheduled for presentation are as follows: "The Value of Night Mining Classes," H. B. Northrup, director, mineral industries extension, Pennsylvania State College, State College, Pa., with discussoin by Charles E. Lawall, director, School of Mines, West Virginia University, Morgantown, W. Va.; "The Action the Pittston Co. Has Taken Toward Reducing Accidents From Roof Falls," Andrew Wilson, safety inspector, Pittston, Pa., with discussion by James Berry, chief, Ohio Department of Mines, Columbus, Ohio; "The Cave-In and Subsequent Gas Explosion of May 27-29, No. 3 Shaft, Woodward Colliery," P. H. Dever, assistant to the general manager, Glen Alden Coal Co., Scranton, Pa., with discussion by Edwin C. Curtis, state mine inspector, Kingston, Pa.

"Factors That Have Caused and Prevented Accidents in Illinois," John G. Millhouse, director, Illinois Department of Mines and Minerals, Springfield, Ill., with discussion by John Lyons, safety engineer, Bell & Zoller Coal & Mining Co., Zeigler, Ill.; "How Should Determinations Be Made as to Whether or Not a Mine Is Gaseous, and How Should the Matter Be Handled," R. M. Lambie, Chief, West Virginia Department of Mines, Charleston, W. Va., with discussion by Dr. J. J. Rutledge, chief mine engineer, Maryland Bureau of Mines, Baltimore, Md.; "Safety Progress in Anthracite and Bituminous Coal Mines," D. Harrington, chief engineer, safety division, U. S. Bureau of Mines, Washington, D. C., with discussion by H. S. Gilbertson, director of personnel, Lehigh Navigation Coal Co., Lansford, Pa.

Tax on Oil and Coal Imports Voted by House

Excise taxes of 10c. per 100 lb. on imported coal, coke, and briquets and 1c. per gallon on imported gasoline and fuel oil were included in the tax bill passed by the House of Representatives on April 1. The sales tax of 2½ per cent was defeated through the opposition of insurgent members of both parties. Inclusion of the tax on imported coal met with the approval of a number of anthracite producers who have been urging a tariff on coal imports. It is expected that the foes of the tax on imported fuel oil, including the particularly active New England interests, will marshal all their forces to persuade the Senate to strike out this provision. Their efforts will be opposed by the National Coal Association and representative bituminous and anthracite producers.

Consolidation Lauded for Subsistence Gardens; Coal Industry Assists Relief Group

THE Consolidation Coal Co. was singled out in the report of the President's Organization on Unemployment Relief as responsible for the most extensive garden project undertaken by any industrial firm. The Consolidation project was started in 1931, when the company realized that the depression in business activity would prevent it from giving full-time work to its employees, and in that year 2,000 acres of land was placed under cultivation in its five divisions. Over 4,000 gardens were planted, and expert advice was rendered by representatives of the agricultural departments of West Virginia University and the Kentucky State College.

The garden produce grown in 1931, much of which was canned, was valued at $400,000. The gardening campaign was supplemented by the stores and industrial relations departments, which distributed bulletins published by the company and the U. S. Department of Agriculture to 10,000 employees. In addition, employees received instruction in making the food dollar stretch as far as possible, without sacrificing nutritive values, through food displays by the stores department; investigations carried on by the students of one of the high schools; and through sample menus prepared by the medical staff. An even larger gardening program, expected to yield $600,000 worth of food, is planned for 1932.

The gardening project is only one of the steps taken by the company to improve the economic and social position of its employees, declared Fred A. Krafft, director of the industrial relations department, in a radio address last month. At present, 90 per cent of the employees are enrolled in the group insurance plan of the company. This plan provides for death benefits varying from $1,000 to $2,000, and sickness or injury benefits of $12 a week for a maximum of thirteen weeks. One-third of the cost of the insurance is paid by the company. In the two years and nine months the plan has been in operation, death benefits of $413,000 and sickness and injury benefits of $372,000 have been paid to workers. Records show that only 18 per cent of the families affected by sickness, injury, or death, had other insurance.

General health and welfare is in charge of the company's medical and public health department, which comprises 23 full-time and several part-time physicians, twelve public health nurses, several dentists, an accredited 50-bed hospital, and fifteen modern medical units in the five divisions. Activities of this department in 1931 included the following: patients visited, 176,000; typhoid inoculations, 21,000; smallpox inoculations, 8,000; physical examinations of applicants for employment, 5,000; babies born, 800; clinics held, 389, with an attendance of over 4,000; food handlers examined for infectious diseases, 350. In addition, milk and water supplies were supervised and inspected, regular sanitary inspections were made in each community, and 600 patients were admitted to the company hospital.

Supervision of the health of school children, conduct of health education classes, and the fostering of community social activities also formed a part of the Consolidation program. The death rate of the company in 1931 was eight per thousand, Mr. Krafft declared, against the general average of twelve. The tuberculosis death rate has been reduced one-half, and no deaths have occurred from typhoid in two years or from smallpox in five years.

The United States Coal & Coke Co., Gary, W. Va., which has promoted gardening since 1910, reported that all of the 2,300 employees now on the payroll cultivated gardens in 1931, according to the President's organization. Before 1930, approximately 50 per cent of the men had gardens, but with the prospects of slack working time last year, the company furnished land, tools, and animals for working the plots, and urged all employees to join in the movement. The total value of garden produce raised last year was $113,000. One major factor in the stimulation of interest was the gardening awards, which have been offered annually by the company.

Fayette County, West Virginia, was one of the several sections throughout the country cited by the organization for excellent work in 1931. Here the activities of the New River Co., Koppers Coal Co., Electro-Metallurgical Co., and the Scioto Coal & Coke Co., which have fostered gardening for a number of years, formed the backbone of the campaign.

Coal Utilization Is Theme Of Midwest Meeting

Utilization of Middle-West coals will be the theme of the Fifth Annual Midwest Bituminous Coal Conference, to be held at Purdue University, Lafayette, Ind., April 14-15. Topics scheduled for discussion at the different sessions are as follows: Industrial session—"Gas and Coal Tests, Municipal Plant, Rochester, Minn."; and "Reconditioning of Power Plants to Burn Midwest Coal"; research session—"Coal Research"; retail dealers' sessions—"Sampling and Analysis of Coal"; "Survey of Small Heating Plants in Indiana"; Relation of Building Insulation to Fuel Consumption"; "Trouble-Shooting in the Small Heating Plant"; and "Serving the Public"; stoker session—"Domestic and Semi-Industrial Stokers."

Among those scheduled to speak or participate in discussions are: L. A. Cowles, Rochester Light and Water Department; J. G. Bentley, fuel engineer, O'Gara Coal Co.; H. A. Eggert, combustion engineer, Old Ben Coal Corporation; A. A. Potter, dean of engineering, Purdue University; M. S. Ketchum, dean of engineering, University of Illinois; Leslie A. Pierson, National Association of Power Engineers; M. M. Leighton, chief, Illinois State Geological Survey; C. E. Plummer and C. C. Whittier, Robert W. Hunt Co.; D. R. Mitchell, University of Illinois; A. P. Kratz, research professor, department of mechanical engineering, University of Illinois; G. E. Parkinson, combustion engineer, Consumers Co.; C. J. Klermund, Klermund Heat Service; A. W. Cole, professor of steam engineering, Purdue University; H. A. Glover, Committee of Ten—Coal and Heating Industries; W. T. Miller, assistant professor of mechanical engineering, Purdue University; F. H. Bird, combustion engineer, Central Indiana Coal Co.; V. G. Leach, combustion engineer, Peabody Coal Co.; and M. A. Tuttle, combustion engineer, Knox Consolidated Coal Co.

V-Belt Suit Settled

Suit of the Dayton Rubber Mfg. Co. against the Allis-Chalmers Mfg. Co., involving the question of infringement of the Allis-Chalmers Geist patent 1,662,511, pertaining to multiple V-belt drives, has been settled out of court. Under a mutual working arrangement, the Dayton company takes a license under the Geist patent, while Allis-Chalmers can operate under Short patent 1,538,303.

Coming Meetings

American Mining Congress; annual coal convention and exposition of coal-mining machinery, Cincinnati, Ohio, May 2-7.

Mine Inspectors' Institute of America; annual meeting, May 9-11, Mallow-Sterling Hotel, Wilkes-Barre, Pa.

National Association of Purchasing Agents; annual meeting, June 6-9, Book-Cadillac Hotel, Detroit, Mich.

Rocky Mountain Coal Mining Institute; annual meeting, June 8-10, at Salt Lake City, Utah.

Illinois Mining Institute; annual boat trip and summer meeting on S.S. "Cape Girardeau," leaving St. Louis June 10 and returning June 12.

Southwestern Interstate Coal Operators' Association; annual meeting at 300 Keith & Perry Bldg., Kansas City, Mo., June 14.

Colorado and New Mexico Coal Operators' Association; annual meeting, Boston Building, Denver, Colo., June 15.

American Society for Testing Materials; annual meeting, June 20-24, Atlantic City, N. J.

American Institute of Electrical Engineers; annual summer convention, Cleveland, Ohio, June 20-24.

Mining Society of Nova Scotia; annual meeting at Baddeck, N. S., June 28-9.

St. Louis Coal Men Fight Smoke

A special committee of two coal men, two equipment men, and three representatives of St. Louis (Mo.) civic organizations was appointed to co-operate with the Citizens' Smoke Abatement League as a result of a meeting of interested parties held last month. Coal men were especially active in offering suggestions for remedying conditions within the city, and proffered wholehearted co-operation. The principal spokesman for the coal industry was C. V. Beck, president, St. Louis Coal Co., and he was seconded by W. J. Jenkins, Consolidated Coal Co. of St. Louis, who acted as chairman; J. C. Muckerman, Polar Wave Division, City Ice & Fuel Co.; N. D. Sullens, Weissenborn Fuel Co.; W. Frank Davis, St. Louis & O'Fallon Coal Co.; George Curran, St. Louis Coal Club; E. J. Wallace, E. J. Wallace Coal Co.; and L. C. Sherril, Electric Coal Co.

Research Fellowships Offered

Five research fellowships in coal and non-metallics are offered by the College of Mines, University of Washington, and the Northwest Experiment Station, U. S. Bureau of Mines. The value of each fellowship is $720 for the twelve months beginning July 1, and graduates of colleges and universities qualified to undertake research investigation are eligible. Coal research will be devoted to studies of the character of coals in relation to their utilization, with particular attention to friability, and to problems of coal cleaning, particularly flotation.

Obituary

GEORGE NICHOLSON, vice-president and assistant general manager, Vulcan Iron Works, died at his office in Wilkes-Barre, Pa., March 15, a few minutes after suffering a heart attack. Mr. Nicholson was for years interested in the development of mining machinery and, in addition to his connection with the Vulcan company, was president of the Hanover Bank & Trust Co., vice-president of the Wyoming National Bank, and vice-president and treasurer of the William S. Nicholson Co.

DAVID NEAL POSTLEWAITE, secretary of the Scioto Coal Co. and the Central West Coal & Lumber Co., died suddenly at Columbus, Ohio, March 12, of acute dilation of the heart. Mr. Postlewaite was long connected with Ohio mining companies in the capacity of attorney, and assisted in the formation of many corporations in Ohio and West Virginia.

W. H. FREGANS, assistant to the president of the Lehigh Valley Coal Co., died suddenly at his office in Wilkes-Barre, Pa., March 9. Mr. Fregans had been employed by the company for 50 years, beginning his career as a clerk.

CHARLES E. LENHART, president of the Century Coke Co. and general manager of the Fayette Coke Co., died at Uniontown, Pa., March 12, at the age of 69.

JAMES BYRNE, 58, general manager of the Byrne Gas Coal Co., died March 14 at Scottdale, Pa.

Personal Notes

W. J. GERMAN, Huntington, W. Va., technical representative of E. I. duPont de Nemours & Co. for the past twelve years, has been made general superintendent of the coal-mining operations of the Pocahontas Fuel Co. and the Pocahontas Corporation. Mr. German succeeds George W. Craft, and will make his headquarters at Pocahontas, Va.

M. W. THOMAS, Jerome, Pa., and GEORGE J. STEINHOUSER, Helvetia, Pa., have been appointed to the bituminous inspection staff of the Pennsylvania Department of Mines.

EDGAR E. GEORGE, who started with the company as a payroll clerk in 1897, was named assistant to the president of the Lehigh Valley Coal Co., Wilkes-Barre, Pa., last month. Mr. George succeeds the late W. H. Fregans.

Circuit Breaker Presented

Westinghouse Electric & Mfg. Co. formally presented its new AB "De-ion" circuit breaker, developed to perform the functions of carbon circuit breakers and fuses without flashing, at a demonstration in the East Pittsburgh (Pa.) laboratories last month. Westinghouse men who participated in the program and presented papers on circuit breaker and switchboard design and operation were: Ralph Leavenworth, J. S. Tritle, J. B. MacNeill, H. J. Lingal, A. G. Vaughn, K. C. Randall, C. B. Stainback, and W. G. Balph.

Pond Creek Mine Started

The new No. 4 operation of the Pond Creek Pocahontas Co., four miles from Bartley, W. Va., started up last month with 75 men employed, according to an announcement by R. E. Salvati, general manager. F. C. Corrothers, superintendent of the other operations of the company, will take the same position at the new mine. J. M. Holbrook is mine foreman. Three hundred and fifty men will be employed when the operation reaches full production of 3,000 tons per day.

Industrial Notes

W. T. ALLEN, for the past eighteen years employed in the sales and engineering departments of the Keystone Lubricating Co., Philadelphia, Pa., has been appointed special representative for the coal-mining department of the company. He will have charge of the sales territory of Illinois, Indiana, and western Kentucky.

GEORGE PAULL TORRENCE, vice-president in charge of the company's Indianapolis (Ind.) plant, was elected president of the Link-Belt Co. at the annual meeting of the stockholders, held on March 22. Mr. Torrence entered the employ of the Link-Belt Co. in 1911 as a sales engineer.

MAVOR & COULSON, LTD., Glasgow, Scotland, has entered into an arrangement with the Joy Mfg. Co., Franklin, Pa., whereby Mavor & Coulson receives the rights to all foreign patents of the Joy company, enabling the organization to sell Joy loaders in all the countries of the world except the United States, in return for ceding to Joy its United States patents and the right to manufacture and sell M. & C. coal cutters and conveyors in this country.

MANCHA STORAGE BATTERY LOCOMOTIVE CO., St. Louis, Mo., has sold to the Goodman Mfg. Co., Chicago, its business, good will, and a portion of its assets. The Mancha business eventually will be moved to Chicago, and will be operated independently by Goodman as a separate company. Distinctive features of the Mancha line of storage battery locomotives and pit-car loaders will be retained.

TRUMBULL ELECTRIC MFG. CO., Plainville, Conn., has transferred F. M. OGLEE, its Chicago representative, to Philadelphia, Pa., to take the place of F. W. Knoeppel, resigned. D. F. LAIRD, Detroit (Mich.) representative, will take Mr. Oglee's place in Chicago.

MORSE CHAIN CO., Ithaca, N. Y., a division of the Borg-Warner Corporation, has been appointed exclusive sales agent for Morse "Pullmore" clutches, manufactured by the Rockford Drilling Machine Co., Rockford, Ill., another division of Borg-Warner.

FRANK R. WHEELER has been appointed special sales representative of the Worthington Pump & Machinery Corporation, Harrison, N. J. Mr. Wheeler will cover the Middle West, with headquarters at the Chicago office of the company.

HERCULES POWDER CO., Wilmington, Del., has made the following changes in personnel: GEORGE H. NORMAN, former head of the technical department, the divisions of which will function separately in the future, has been made manager of the development department; H. E. KAISER and G. E. RAMER will supervise research, and experiment and engineering activities, respectively; and J. M. MCVEY is appointed assistant manager of the development department.

C. O. BARTLETT & SNOW CO., Cleveland, Ohio, has transferred C. W. Ross from the Philadelphia (Pa.) office to New York City, where he will assist W. H. Norrington, manager, in serving the requirements of the Eastern territory for conveying, drying, and crushing machinery.

Coal Mine Fatality Rate Rises in February, But Is Lower Than a Year Ago

ACCIDENTS at coal mines in the United States in February, 1932, resulted in the death of 129 men, according to information received from state mine inspectors by the U. S. Bureau of Mines. This was 37 more than in the preceding month and 16 more than in February, 1931; the increases were due to a major disaster in February. February production was 32,032,000 tons, an increase of 243,000 tons over January and a decrease of 4,767,000 tons from the record of February, 1931. The death rate per million tons of coal mined in February, 1932, was 4.03, against 2.89 in January, and 3.07 in February, 1931.

For bituminous mines alone the February death rate was 3.93, based on 110 deaths in mining 28,013,000 tons. In January of the present year there were 77 fatalities for 27,892,000 tons of coal, resulting in a death rate of 2.76; in February, 1931, 71 deaths occurred in mining 31,408,000 tons of coal giving a fatality rate of 2.26.

Similar reports for Pennsylvania anthracite mines showed that 19 men were killed and that 4,019,000 tons of coal was produced in February, 1932, resulting in a death rate of 4.73. During February, 1931, there were 42 deaths in producing 5,391,000 tons of coal, resulting in a death rate of 7.79, while the record in January, 1932, showed 15 fatalities, 3,897,000 tons, and a death rate of 3.85.

Reports for the first two months of 1932 show that accidents at coal mines in the United States caused the loss of 221 lives. Production of coal during this period was 63,821,000 tons, resulting in a fatality rate of 3.46, as compared with 3.60 for the same two months last year when 293 deaths occurred in producing 81,498,000 tons. The two-month record for bituminous mines in 1932 showed a fatality rate of 3.34 based on 187 deaths and 55,905,000 tons, as compared with a rate of 3.00 based on 210 deaths and 69,950,000 tons in 1931. Similar records for anthracite mines during the first two months of 1932 showed a fatality rate of 4.30, with 34 deaths and a production of 7,916,000 tons, as compared with a rate of 7.19, 83 deaths, and 11,548,000 tons for January and February of 1931.

One major disaster—that is, a disaster in which five or more lives were lost—occurred during February, 1932. This was an explosion in a mine at Boissevain, Va., Feb. 27, in which 38 men lost their lives. No major disasters occurred in February a year ago. Thus far in 1932 there have been two major disasters causing the death of 44 men, while in the corresponding period of 1931 there were three major disasters and 41 deaths. Based exclusively on these disasters, the death rates per million tons were 0.689 and 0.503, respectively.

Comparative fatality rates for 1932 and 1931 are as follows:

Fatalities at United States Coal Mines and Death Rates Per Million Tons By Causes of Accidents

Cause	Bituminous: Number Killed	Bituminous: Killed per 1,000,000 Tons	Anthracite: Number Killed	Anthracite: Killed per 1,000,000 Tons	Total: Number Killed	Total: Killed per 1,000,000 Tons
January – February, 1931						
All causes	210	3.002	83	7.187	293	3.595
Falls of roof and coal	103	1.473	49	4.243	152	1.865
Haulage	37	.529	8	.693	45	.552
Gas or dust explosions:						
Local explosions	...	.....	4	.346	4	.049
Major explosions	41	.586	..	.....	41	.503
Explosives	1	.014	5	.433	6	.074
Electricity	7	.100	..	.....	7	.086
Surface and miscellaneous	21	.300	17	1.472	38	.466
January – February, 1932						
All causes	187	3.345	34	4.295	221	3.463
Falls of roof and coal	89	1.592	23	2.905	112	1.755
Haulage	28	.501	5	.632	33	.517
Gas or dust explosions:						
Local explosions	1	.018	..	.....	1	.016
Major explosions	44	.787	..	.....	44	.689
Explosives	1	.018	2	.253	3	.047
Electricity	7	.125	1	.126	8	.125
Surface and miscellaneous	17	.304	3	.379	20	.314

Coal-Mine Fatalities During February, 1932, by Causes and States

(Compiled by Bureau of Mines and published by *Coal Age*)

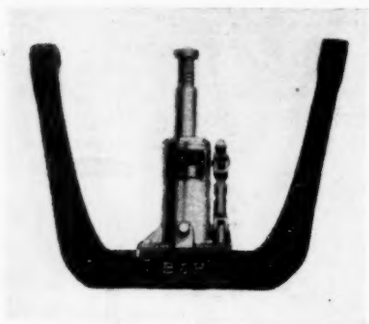
State	Underground: Falls of roof (coal, rock, etc.)	Underground: Falls of face or pillar coal	Underground: Mine cars and locomotives	Underground: Explosions of gas or coal dust	Underground: Explosives	Underground: Suffocation from mine gases	Underground: Electricity	Underground: Animals	Underground: Mining machines	Underground: Mine fires (burned, suffocated, etc.)	Underground: Other causes	Underground: Total	Shaft: Falling down shafts or slopes	Shaft: Objects falling down shafts or slopes	Shaft: Cage, skip, or bucket	Shaft: Other causes	Shaft: Total	Surface: Mine cars and mine locomotives	Surface: Electricity	Surface: Machinery	Surface: Boiler explosions or bursting steam pipes	Surface: Railway cars and locomotives	Surface: Other causes	Surface: Total	Total by States: 1932	Total by States: 1931
Alabama	2	....	....	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	2	1
Alaska	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0
Arkansas	....	1	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1	0
Colorado	1	....	2	....	....	....	....	....	....	....	....	3	....	....	....	....	....	....	....	....	....	....	....	....	3	1
Illinois	4	....	1	....	....	....	....	....	....	....	....	5	....	....	....	....	....	....	....	....	....	....	1	1	6	8
Indiana	1	....	....	....	....	1	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	2	2
Iowa	1	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1	1
Kansas	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	1
Kentucky	6	2	....	....	....	....	....	....	....	....	....	8	....	....	....	....	....	....	....	....	....	....	....	....	8	9
Maryland	1	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1	0
Michigan	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0
Missouri	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0
Montana	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0
New Mexico	1	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1	0
North Dakota	2	....	....	....	....	....	....	....	....	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	2	0
Ohio	2	....	....	....	....	....	....	....	....	....	....	2	1	....	....	....	1	....	....	....	....	....	....	....	3	4
Oklahoma	1	....	....	....	....	....	....	....	....	....	....	1	....	....	....	....	....	....	....	....	....	....	....	....	1	1
Pennsylvania (bituminous)	7	1	3	....	....	....	....	....	....	....	....	11	....	....	....	....	....	....	....	....	....	....	....	....	11	20
Tennessee	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	1
Texas	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0
Utah	2	....	1	....	....	....	....	....	....	....	....	3	....	....	....	....	....	....	....	....	....	....	1	1	4	2
Virginia	....	....	....	38	....	....	1	....	....	....	....	39	....	....	....	....	....	....	....	....	....	....	....	....	39	2
Washington	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	0
West Virginia	12	2	6	....	....	....	1	....	....	....	1	22	....	....	....	....	....	1	....	....	....	....	2	3	25	16
Wyoming	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	0	2
Total (bituminous)	43	6	13	38	..	1	2	....	....	....	1	104	1	....	....	....	1	1	....	....	....	....	1	3	5	110	71
Pennsylvania (anthracite)	11	4	2	....	1	....	1	....	....	....	....	19	....	....	....	....	....	....	....	....	....	....	....	....	....	19	42
Total, February, 1932	54	10	15	38	1	1	3	....	....	....	1	123	1	....	....	....	1	1	....	....	....	....	1	3	5	129	....
Total, February, 1931	54	12	20	1	4	....	4	1	2	....	9	107	1	....	....	....	1	1	....	....	....	....	1	4	5	.....	113

WHAT'S NEW

IN COAL-MINING EQUIPMENT

Rail Bender With Hydraulic Jack

B. & H. Railbender Co., Harlan, Ky., has developed a hydraulically operated rail bender, consisting of a specially built Blackhawk hydraulic jack with a capacity of 7 tons bolted into a frame composed of an annealed electric steel casting. Through the use of the hydraulic principle, the company states, easy strokes on the pump handle will put tons of pressure on the ram of the jack. Precision control is possible at all times, it is declared. At present, the No. 20 rail bender, for use in bending and straightening 12-, 16-, and 20-lb. rails, is being manufactured. The No. 40 (30- and 40-lb. rails) and the No. 60 (60-lb. rails) will soon be offered, according to the company, and a size for railroad rails will be manufactured later on.



B & H Rail Bender

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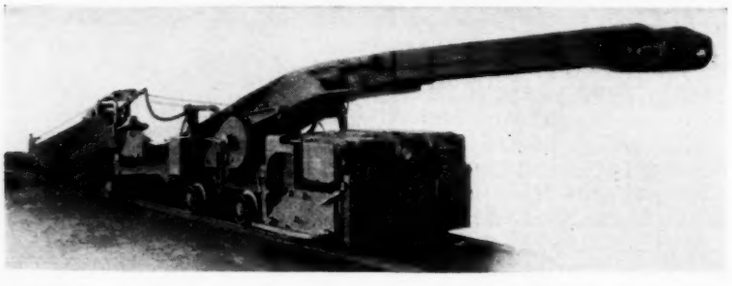
Car Spotter for Loaders

Jeffrey Mfg. Co., Columbus, Ohio, offers the Jeffrey "car spotter" for use in handling mine cars to and from loading machines. The spotter works between the machine and the car, handling one car at a time. With this system, the company says, one man can operate the spotter and trim the car at the same time, and do a much better job than is possible with the standard gathering locomotive, two men, and a string of cars. Elimination of whistle signaling and other control difficulties with the locomotive and cars is said to allow better positioning of the car under the loading conveyor, thus assisting in distribution of the coal and enabling the car to be loaded more heavily. The proximity of the controls on the spotter to the controls of some types of loaders also allows operation of the spotter by the loading machine runner, if desired.

Handling one car at a time, the car spotter, according to the company, will take care of the same number of cars in a given time as an 8-ton locomotive, and will do it with less slipping of the wheels. Travel and switching in car changing also is reduced, it is asserted, and the company points out, further, that the spotter is advantageous in opening up rooms, serving as a gathering locomotive until the first breakthrough is driven. Equipment consists of a standard locomotive motor geared to both axles, and a double-direction, mechanically driven cable reel holding 375 ft. of cable for connecting the spotter to the loader. Weight is 5 tons complete, and the spotter is built in gages from 36 to 48 in. Speed is 4.75 m.p.h. when developing a tractive effort of 500 lb. Maximum speed is 3.75 m.p.h. with a tractive effort of 2,500 lb. Over-all height is 32¾ in.

Jeffrey "Car Spotter" With Jeffrey Loading Machine



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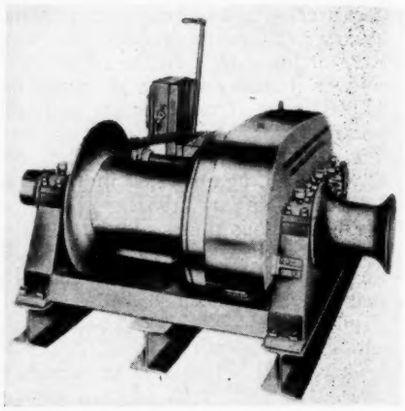
Drum-and-Capstan Car Puller

Fridy Hoist & Machinery Co., Mountville, Pa., offers a new combination drum-and-capstan car puller for spotting a train of loaded railroad cars or for handling a trip of mine cars at a mechanical loading station inside the mine. It can be operated in either direction, the company says. Standard motor ratings for railroad-car use are 10, 15, and 20 hp., and at slow speed the hoist is said to be capable of exerting a pull up to 500 tons, using steel cable for long hauls and manila rope on the capstan for distances up to 300 ft. For mine use, the car puller can be had with a 7½- or 10-hp. motor and either with or without the horizontal capstan. According to the company, the construction of the clutch guards against overloads and permits a positive grip and release of the drum with only a slight movement of the operating lever. Controls are said to be within easy reach of the operator.



Fridy Drum-and-Capstan Car Puller

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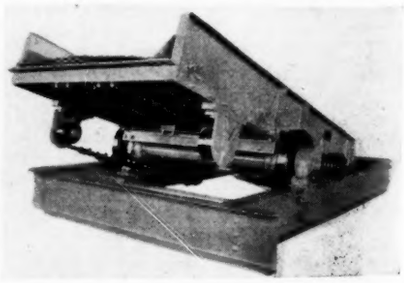
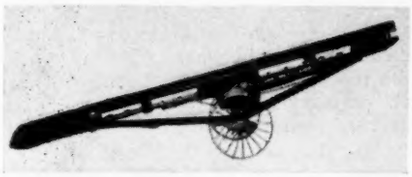
Heavy-Duty Vibrating Screens

Link-Belt Co., Philadelphia, Pa., announces two new types of vibrating screens, as follows: Link-Belt, positive-drive type, heavy-duty vibrating screen with single and multiple decks; Link-Belt, unbalanced pulley type, heavy-duty vibrating screen with single and multiple decks. With the positive-drive type, any given fixed amplitude with suitable shaft speeds can be furnished. The amplitude of vibration is fixed at



Link-Belt, Positive-Drive-Type, Heavy-Duty, Vibrating Screen



Link-Belt "Bituminous Type" Portable Flight Conveyor

the factory to suit the work the screen is to do, but the angle of screen inclination, speed of operation, and direction of rotation can be changed at any time to suit the kind, size, and condition of the material to be screened. Screen cloths are said to be easily accessible and are put under crosswise tension by side plates, which also serve as wearing plates and prevent leakage along the sides. Cantilever leaf springs maintain the screen box at a constant angle. A steel subframe is regularly supplied as a part of the screen.

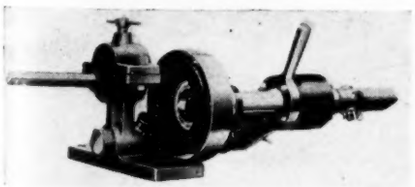
The unbalanced-pulley-type heavy-duty screen is said to be designed for high-speed work where the material is sticky, and also for close sizing where the screen openings are not large. The amplitude can be varied by the user from zero to ¼ in. by changing the counterweights, said to be a valuable feature where the condition of the material is subject to variation. Screen angle, speed, and direction of operation also can easily be changed, it is asserted. Cantilever leaf spring design, method of applying screen cloth, and other details are similar to those of the positive-drive type screen.

Link-Belt Co., Philadelphia, also has brought out a new "bituminous type" portable flight conveyor. Length of conveyor from center to center is 21, 26, or 31 ft., and the capacity is 90 tons per hour of uniform feed for the 26- and 31-ft. machines, and 60 tons per hour for the 21-ft. machine. A 3-hp. motor drives the 21-ft. machine, while the other two are operated by 5-hp. motors. The hoisting mechanism is power-operated, and swiveling-type axles are included.

Shank Grinder for Drill Steel

Ingersoll-Rand Co., New York City, announces the 4K shank grinder, a tool for facing the striking ends of drill steel shanks, rock drill and paving breaker pistons, and anvil blocks. The machine consists of a "multi-vane" air grinder mounted in a frame so as to allow the grinding wheel to be passed back and forth by means of a handle. The grinder mounting is fitted with a wing nut adjustment working under spring tension for feeding the wheel up against the face being ground. The steel or piston is held in a self-centering V-block clamp incorporated in the frame. A countersinking bit is located in the center of the grinding wheel for removing the burr from the hole in hollow drill steel. The complete machine can be bolted securely to the top of a work bench or other suitable location.

4K Shank Grinder



The 4K grinder, according to the company, insures the uniform and correct dressing of striking faces and eliminates rounded drill-steel shank ends and cupped pistons, which are responsible for much of the spalling and breaking of these parts. Its use, it is said, results in better performance of drills and paving breakers and reduces maintenance and replacement costs.

Electrical Equipment Offered

Two new "Tungar" battery chargers (12- and 24-battery "full-wave" types) have been announced by the General Electric Co.'s merchandise department, Bridgeport, Conn. The new chargers, according to the company, employ the new plug-in type of control for rapid and accurate charging, a regulating panel so arranged that anybody can operate the chargers without previous experience, and a new automatic relay to prevent battery damage in case of short-circuits or line failure. The 24-battery unit uses an improved four-way charging system, the company says, enabling it to charge batteries on either half- or full-wave or a combination of both at the same time.

General Electric Co., Schenectady, N. Y., offers a new line of pushbutton stations (Type CR-2940) for general industrial applications. These stations are divided into three classes: those which make a momentary contact; those which maintain the contact; and those which do both. The momentary-contact unit provides both a normally open and normally closed circuit. Allowance for ample creepage is said to make this unit suitable for 600-volt circuits. Maintaining-contact selector switches are available for operation as single-pole, single-throw; single-pole, double-throw; or double-pole, single-throw knife switches.

The stations consist of one or more of the following units inclosed in a case: pushbutton (momentary contact); selector switch (maintaining contact); and an indicating lamp receptacle. In stations employing indicating lamps, 18-volt lamps with color caps are used. For higher voltages, a separately mounted resistor is used in series with the lamp except in cases where a certain voltage is required, in which case the resistor may be included in the station. Wall-mounted stations have a two-piece inclosing case, double conduit knockouts in top and bottom, one knockout in the back, and a locking bar (optional). Stations also are available in modified form for mounting on the back of ⅛- to 2-in. panels.

A new gasket material, said to be moisture-proof and highly oil-resistant, is announced by the General Electric Co., and is recommended by that organization for use where the primary purpose of the gasket is to exclude moisture. The material, known as "1,000 Compound," is said to be a white, odorless, sulphur-free rubber compound, available in both sheets and molded shapes. The company asserts that it requires no sticker, is extremely tough, very flexible, can be used repeatedly, is not affected by exposure to weather, and when under compression is not attacked by cold oil. In contact with hot oil, it is said to be practically unaffected when inclosed in recessed joints under compression. Mildly alkaline and dilute acid solutions apparently do not affect the compound.

Almost complete immunity from lightning failures and a reduction in fuse blowing, as well as a lowering of installation cost, have been accomplished in a new scheme of interconnection of distribution transformers and lightning arresters, the General Electric Co. says. Radical departures have been incorporated in the design of the lightning arresters, which are suspended inside the transformer tanks. The arresters are connected to the incoming high-voltage lead and the grounded lead on the low-voltage side, the usual ground connection for arresters being omitted. They can be installed in modern pole-mounted transformers without change—steel transformer tanks fabricated within the past two years or more have been designed with such in mind. In the new scheme the tank is left ungrounded, in accordance with customary practice, but the secondary must be thoroughly grounded. The arresters, completely assembled and especially designed for this application, are being produced for 2,400- and 4,800-volt service.

A new "Thrustor"-operated valve allowing for centralized remote control of gases or liquids under pressure, is announced by the General Electric Co. This valve is available in sizes ranging from 2 to 12 in. for 125-600 lb. per square inch and is designed for general industrial applications. The new valve also may be readily installed in place of hand-operated valves. In operation, the Thrustor, a self-contained power unit consisting of a motor controlling an improved hydraulic cylinder, applies pressure to the valve to open or close it. A spring is used to return the Thrustor to its original position, and it is readily adjustable for rapidly or slowly opening valves.

The General Electric Co., announces a new line of shoe-type, weather-proof Thrustor-operated brakes (Type

CR9516) for alternating-current motors on mill, crane, hoist, and similar applications where severe service requirements must be met. These brakes, the company declares, provide quick, cushion-like braking in either direction of rotation with either light or heavy loads, and are adjustable for braking torque over a wide range.

Close and accurate control of the frequency of current interruption in line welding, and an increase in speed of interruption up to 1,800 per minute are among the advantages of a new type of Thyratron tube timing control claimed by the General Electric Co. The new control replaces mechanical interrupters, and operates in synchronism with the alternating-current supply of the welding machine. The weld is always started at a predetermined point in the voltage wave and stopped when the current passes through zero. Thus, the company says, the period of current application can be accurately controlled even with "on" times of but one or two cycles. The new synchronous tube timer supplements, and is designed to work in conjunction with, the General Electric welding control (Type CR-7503) recently announced which uses Thyratron tubes instead of contactors for interrupting the flow of current. By a combination of the two equipments, a close degree of accuracy and a high welding speed are obtained, the company asserts.

Permissible Hand Lamps

Mine Safety Appliances Co., Pittsburgh, Pa., has developed two new lines of permissible hand lamps and portable floodlights. The hand lamps come in two models (H and K), and consist of standard H and K nickel-iron alkaline mine lamp batteries, respectively, a Bakelite headpiece with either polished or matte surfaced reflectors, and two-filament gas-filled bulbs operated by a switch on the headpiece. When equipped with polished reflectors, the H and K lamps may be used as spotlights, developing 350 and 600 beam candlepower, respectively. Where a

Model K Hand Lamp

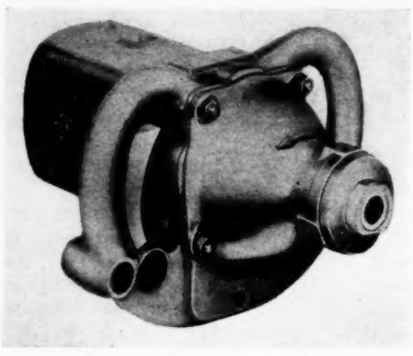
M-S-A Portable Floodlight

spread of light is required, the matte reflector is recommended.

The permissible portable floodlights are available in two models—E and G. Model E consists of six Type M-14 Edison cells in a steel battery container, while Model G has four cells. Both lamps can be used as floodlights with matte-surfaced reflectors, or as search lamps with polished reflectors. Both models also are available as non-permissible units, in which case they are not equipped with fuse, Yale-type lock, safety lens, or safety bulb mounting.

Inclosed Electric Coal Drill

The Colonial lightweight electric coal drill with entirely inclosed motor is offered for use in coal mines by the Colonial Supply Co., Pittsburgh, Pa. This drill, according to the company, offers safety and mechanical features unusual in drills for use in non-gaseous



Colonial Lightweight Electric Coal Drill

mines. Dust and other foreign matter are kept out of the motor and working parts, materially reducing repairs necessitated by the wearing action of dirt, the company says.

Other features stressed by the company are: lightweight (33 lb.); special alloy steel pinions and gears, heat-treated and hardened to withstand heavy loads and hard usage; automatic quick-releasing switch operated from the handle; SKF ball bearings with standard dimensions, easily accessible for inspection and replacement if necessary; and a housing designed with sufficient area to dissipate heat and keep the motor at a safe temperature under all ordinary operating conditions. The drill is equipped with a means of attaching the company's design of auger, but an adapter is supplied with each drill so that the standard, flat-taper-shank auger may be used if desired. The drill is available for 250 volts, d.c.

Belt Dressing

Diamond Rubber Co., Akron, Ohio, announces "Griptite," a new belt dressing for rubber belts, which it states is not greasy, inflammable, or harmful to belt or pulley. According to the company, the dressing doubles the pulling power of the belt immediately upon application, and its effectiveness increases with use. The dressing also is said to retain its tackiness much longer than usual.

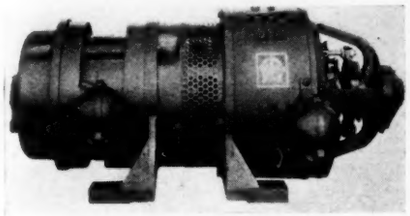
New Gas Mask

E. D. Bullard Co., San Francisco, Calif., offers the Bullard gas mask with one-piece molded face piece, which is said to be so shaped as to conform to any wearer's face. The rubber used in the face piece, it is declared, is specially compounded to retain its elasticity and oxidization. The mask is suspended from the top of the head and is held in place with the minimum tension by straps which run around the head. All straps are adjustable, and a neck snap is included for quick removal. Castings connecting the face piece with the canister hose are designed to give a minimum breathing resistance, it is asserted. Triangular eyepieces are provided to give maximum vision in all directions, and the maker declares that they are easily removable and will not fog.

Bullard Gas Mask

Motor-Generator Set Made As One Unit

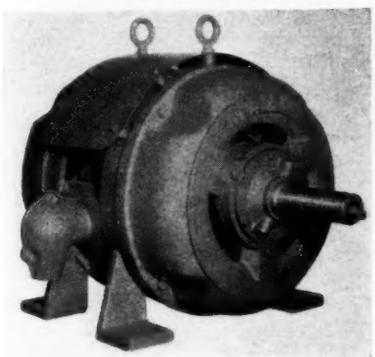
Reliance Electric & Engineering Co., Cleveland, Ohio, has developed a new, one-unit, motor-generator set for ratings of from 1 to 5 kw. In these sets, the company says, the usual a.c. motor and d.c. generator are combined into a single unit, requiring only two bearings. Induction-motor rotor and d.c. armature are mounted on one shaft. This design, it is asserted, provides a rugged, compact construction which requires less space. In addition, the work



Reliance, One-Unit, Motor-Generator Set

of connecting and aligning two units is eliminated. The sets can be furnished for operation on either two- or three-phase circuits at 125 or 250 volts.

The Reliance company also has developed drip covers for application to its line of a.c. or d.c. motors. They are used, the company says, to protect the

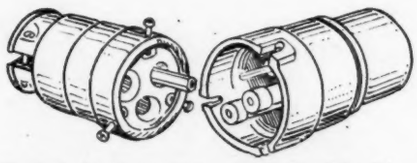


Reliance Drip Cover Applied to Motor

equipment from dripping water, acids, or other corrosive liquids. Such covers, it is said, help materially in keeping equipment clean and reducing maintenance cost. They are made of heavy-gage sheet steel, and are bolted to the frames so that an opening is provided for free air circulation.

Plugs for Individual Fusing

Crouse-Hinds Co., Syracuse, N. Y., has developed the Type CPE, "Arktite," 15-amp., 250-volt, three-pole fusible plugs for individual fusing of portable machines. According to the company, small portable tools and lighting and heating apparatus need individual fusing for protection against short-circuits in case of cord or insulation failure, while high-capacity or high-frequency tools

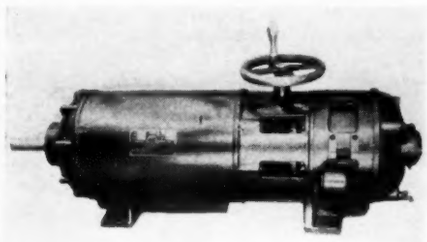


Exploded View, Type CPE Fusible Plug

protection is needed not only for cord or insulation failures but for overload, stalling, or single-phasing. Type CPE fusible plugs, the company says, provide a fusible cutout for this service that always is associated with a particular tool, and which can be fused very closely to the capacity of the tool.

Variable Speed Drive Is Self-Contained

A variable-speed drive which combines motor, speed changer, speed reducer, and control in a single housing has been developed by the Stephens-Adamson Mfg. Co., Aurora, Ill. It is made in sizes to deliver $\frac{1}{4}$ to $7\frac{1}{2}$ hp., and the company says that it is compact, easily mounted, quiet, and more efficient due to the elimination of at least two



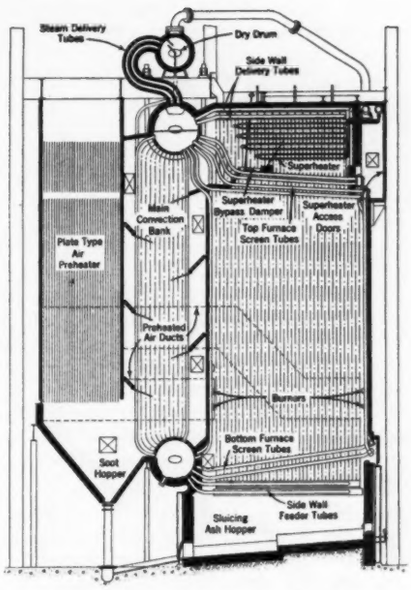
Stephens-Adamson Variable Speed Drive Unit

sets of gear reductions. The unit is delivered ready to couple to the machine. Motor section usually is wound to operate at 1,200 r.p.m., and the drive, the maker states, will deliver the rated power at any speed between 24 and 144 r.p.m. or 120 to 720 r.p.m. Output speed is regulated by turning the handwheel on top of the housing.

Moving parts exposed consist only of the output shaft, and the unit, according to the company, can be mounted in any position with four bolts. Long life also is claimed by the maker, as mounting conditions are ideal and the speed reducer mechanism runs in oil, with entire protection from dust and atmospheric conditions.

Multiple Circulation Boiler

Combustion Engineering Corporation, New York City, offers the C-E multiple circulation boiler in sizes ranging from 2 000 to 26,000 sq.ft. of heating surface. Tubes in the boiler are arranged, according to the company, to give a double



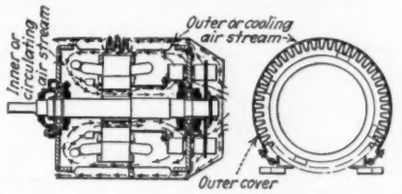
Side Elevation of Steam Generator

circulation, thus equalizing steam liberation in the upper front and middle drums and eliminating the intense turbulence present in multiple-drum, bent-tube boilers where the greater part of the steam is liberated in the front drum. This construction, it is said, insures adequate circulation and correct steam liberation under the most severe operating conditions.

A standard steam generating unit fired with pulverized coal is now offered by this company in eight sizes ranging from 70,000 to 400,000 lb. of steam per hour, from and at 212 deg. F. The unit combines all the elements required for burning fuel, generating and superheating steam, recovering heat, and disposing of ashes. There are no openings in the casing, the company says, and all four walls of the furnace are water-cooled. The superheater bypass damper affords a means of controlling superheat temperature.

Fan-Cooled Induction Motor Is Totally Inclosed

Lincoln Electric Co., Cleveland, Ohio, announces a new line of "Linc-Weld," totally inclosed, fan-cooled, induction motors from 1 to 50 hp. Arc-welded steel construction, double-sealed



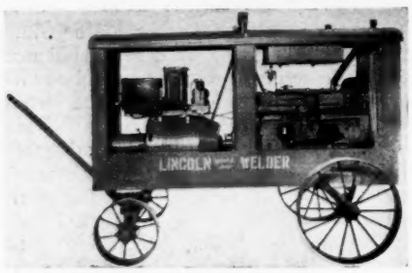
"Linc-Weld" Totally Inclosed Fan-Cooled Motor, Showing Air Circulation

ball bearings, and a removable cover to facilitate cleaning are points stressed by the company, which says that its de-

sign is such that the temperature rise is considerably less than the allowable rise for motors of this type.

The Lincoln company also has developed a gas-engine-driven welder for use with large electrodes in all types of field construction work. According to the company, the machine is rated at 400 amp., with a current range up to 500 amp., and is of the variable-voltage, single-operative type, working at 1,500 r.p.m.

The welding generator is driven by a six-cylinder gasoline engine with a S.A.E. rating of 33.75 hp. and a brake horsepower of 55 at 1,500 r.p.m. Automatic throttle control has been installed, the company says, to permit the engine to idle at half speed when the arc is not going. A time delay system also has been incorporated in the equipment, according to the manufacturer, to keep the engine running at full speed during momentary interruptions of the arc. Slowing-down does not occur until after a definite time interval. This provision, it is asserted,

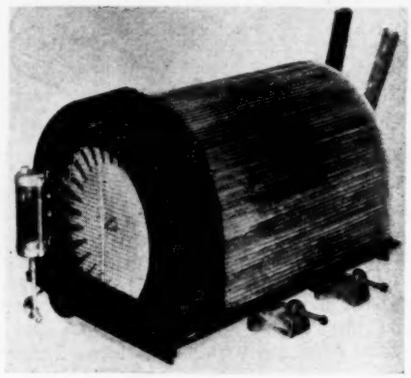


Lincoln "Stable Arc" Welder

permits the changing of electrodes without affecting the speed. However, if the operative is forced to change his position, the engine slows down. Use of the throttling system is said to result in savings in upkeep and in gasoline consumption. Over-all dimensions, exclusive of wheels, which are optional, are 104, 32, and 58 in. Weight is about 3,500 pounds.

Inclosure for Open-Frame Motors

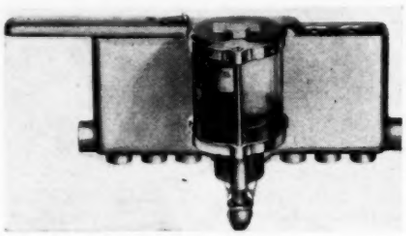
To prevent accumulation of dust, dirt, or moisture on the parts of open-frame motors, the Daun-Walter Co., Milwaukee, Wis., has perfected a new electric motor inclosure made of corrugated copper. End walls and supporting baseplate are made of steel. A cooling fan is mounted on the motor shaft opposite the pulley end by a shaft adapter. By means of the fan and a deflector, a current of air is carried over the copper corrugations, carrying away the heat developed by the motor. The inclosure is designed to permit mounting on motor slide rails for belt adjustment, and may easily be opened for inspection of the motor, the company says. Sizes to fit all open-frame two- or three-phase motors, a.c. motors,



Daun-Walter Inclosure for Open-Frame Motors

and all d.c. motors from 5 to 100 hp. may be obtained.

The Daun-Walter Co. also offers an adjustable wick oil-feed unit for lubricating bearings. According to the company, the instrument controls the oil delivered from a reserve supply of ½ pt. to 2 gal. It consists of two main parts, the first of which is a constant-level oil control that provides storage space and maintains a constant level of oil in the wick chamber. The second part is the multiple-unit adjustable wick-oil feed, made with four, eight, or twelve outlet units. An adjustment is provided



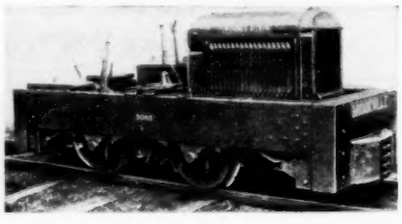
Daun-Walter Wick Oil-Feed Unit

whereby a feed of as low as four drops per hour can be maintained. Advantages cited by the company are: no moving parts; no losses of oil from faulty lubrication; positive, continuous feed; and instant check on the feed.

Locomotive Has Five Speeds

Brookville Locomotive Co., Brookville, Pa., has announced a new series of 8- and 10-ton gasoline locomotives powered with the Model "300" McCormick-Deering industrial power unit. Designations of the 8- and 10-ton machines are, respectively, BMD-8 and BMD-10. Five speeds in either the forward or reverse direction are available, the range lying between 2 and 16 m.p.h. Both locomotives are available in any track gage from 22 to 56½ in., or even wider. Wheelbase, over-all height, and other dimensions are variable within limits to suit requirements, the company says.

Brookville BMD-8 Locomotive



Kva.-Demand Meter

The Sangamo Electric Co., Springfield, Ill., offers the Type S kva.-demand meter for use in the measurement of demand. Construction details and advantages detailed by the company are:

The meter is an auxiliary device controlled by two watthour meters, measuring the energy and reactive component, respectively to give, on a single chart, the following information: kilovolt-ampere demand, kilowatt demand, maximum kilowatt demand, power factor at the time of the demand, reactive component demand, time that the demand occurred, energy component in kilowatt-hours, and the reactive component in reactive kilovolt ampere hours.

Type S meter can be built for either 50- or 60-cycle operation and, as it is generally used with meters employing instrument transformers, the motors are regularly built for 115-volt operation. Meters for 25- and 30-cycle operation cannot be supplied unless there is available a control circuit of 50 or 60 cycles for operation of the motors in the kilovolt-ampere meter. The watthour meters operate on 25- or 30-cycle currents. Timing motor, chart motor, and pen motor are of the self-acting, shaded-pole type. Ball bearings, with adequate oiling space, are provided in both upper and lower housings. The latter is equipped with a spring support for easy adjustment to secure noiseless and efficient operation. Synchronous speed of the timing motor is 1,200 r.p.m. for 60 cycles and 1,000 r.p.m. for 50 cycles.

Kilovolt-Ampere Demand Meter